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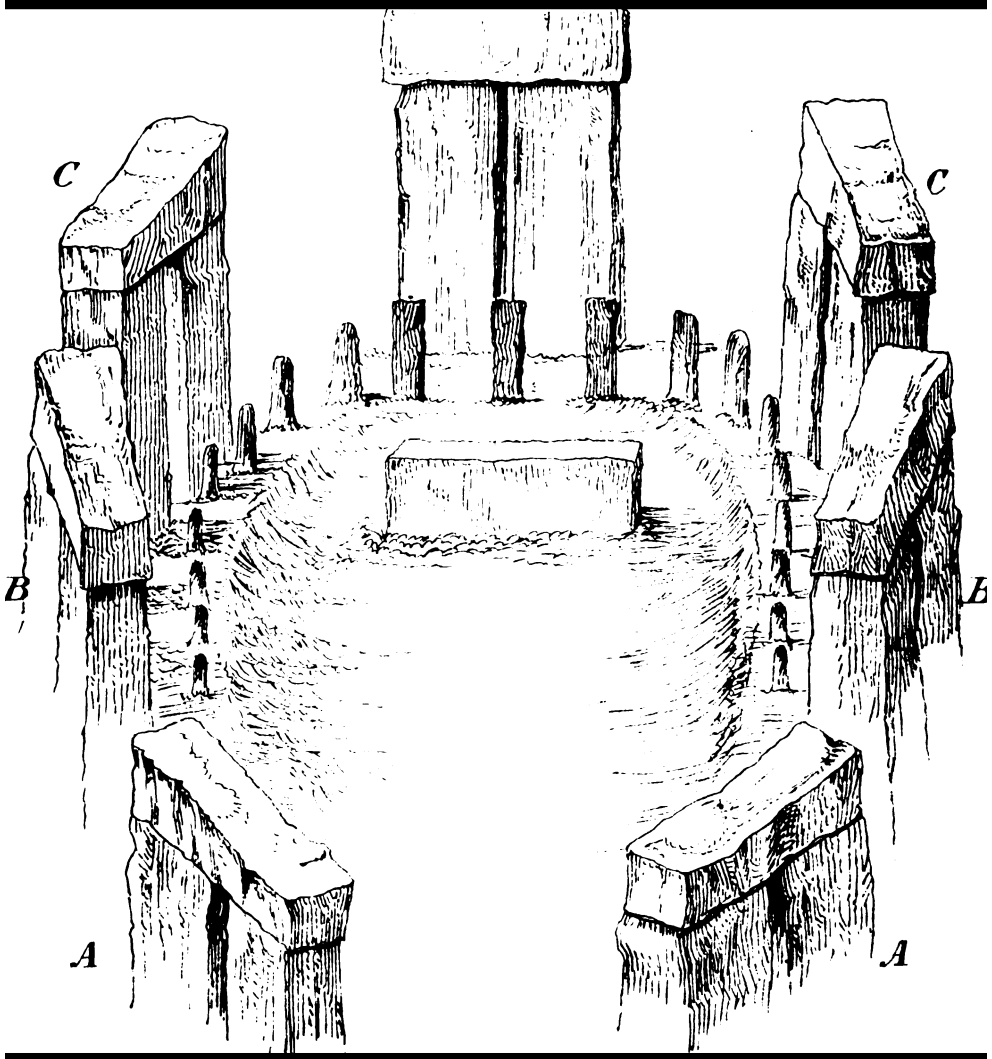

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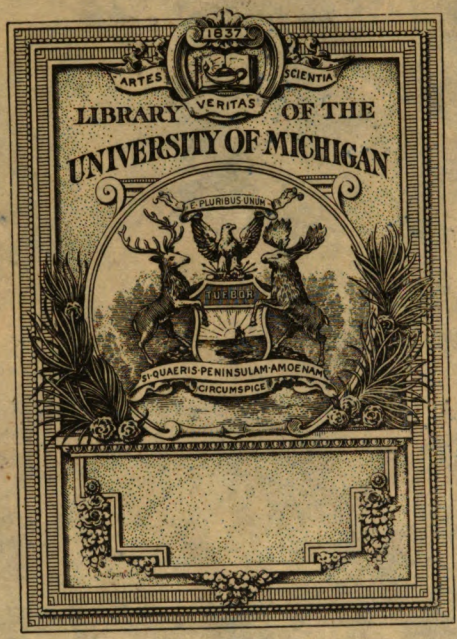

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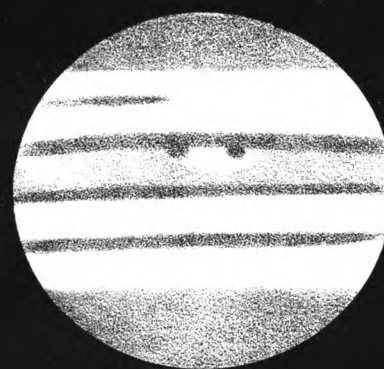

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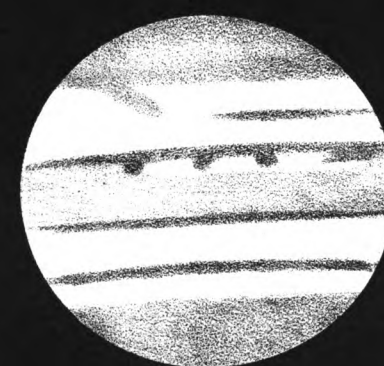

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THE

ASTRONOMICAL REGISTER:

A MEDIUM OF COMMUNICATION
FOR AMATEUR OBSERVERS, AND ALL OTHERS INTERESTED IN THE
SCIENCE OF ASTRONOMY.

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BY THE REV. J. H. BROOME.

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The Astronomical Register.

No. 85. JANUARY. 1870.

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ROYAL ASTRONOMICAL SOCIETY.

Session 1869-70.

Second Meeting, December 10, 1869.

Admiral Manners, *President*, in the Chair.

Secretaries—Mr. W. Huggins and Mr. E. J. Stone.

The Minutes of the last meeting were read and confirmed.

Thirty-two presents were announced, and the thanks of the Society given to the respective donors. Among the presents was a very beautiful coloured representation of the solar spectrum, published in France, and presented by Mr. Ladd, and which included not only the visible spectrum but the ultra violet part and lines.

Charles Lambert, Esq., Charles Joseph Corbett, Esq., and John Wood, Esq., B.A.,

were balloted for, and duly elected Fellows of the Society.

The following papers were announced and partly read:—

On Chinese Astronomy; by Mr. Williams, Assistant-Secretary.

At the last meeting Mr. Williams presented to the Society a MS. volume containing a translation by him of all the Chinese cometary observations, extending over more than 2,000 years;

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and the present paper constituted the introduction to that work, giving an account of the state of Chinese Astronomy, from which the author read copious extracts. It appears that the earliest recorded movement in astronomical science occurred about 2357 B.C., when the emperor Yaou, as mentioned in a book called "The Shoo King," laid down the method to be pursued by the astronomers He and Ho in making their observations. The emperor Whang Te appears to have introduced the system of reckoning by cycles of 60 years; and as we are now in the 76th of these cycles, the date previously given is thus ascertained; and the year 2637 B.C. may be taken as the beginning of their chronology. Whang Te is also said to have been the first discoverer of the lunar cycle of 19 years, introduced by Meton more than 2,000 years afterwards. The book "Shoo King" is evidently a work of the earliest antiquity, and is believed to be genuine by the best scholars. In it the emperor Yaou, who began to reign 2356 B.C., gives instructions to the astronomers to observe the heavens, to complete the calendar, and to construct instruments to represent the motions of the sun, moon, and stars forming the signs of the zodiac. They were also to impart information to the people on these points, and full particulars of the heavenly bodies are given. In the second part of the work the emperor establishes a division of labours; one is sent to observe the sun in a particular place to the east; and the duties of all are precisely defined. One star in particular is to have great attention paid to it at the vernal equinox; and this appears to be α Hydræ, which it is stated was then the equinoctial point; and, allowing for the precession of the equinoxes, this would show the date of the instructions to be 2306 B.C. Other observers were to take up positions for observing the summer and winter solstices and the autumnal equinox, and stars about 6h. R.A. apart were indicated for their use. It is mentioned that the year contained 366 days, and it is evident that the sidereal year was meant, as the common year of 365 days is also referred to in the commentary. There are many other allusions, showing great progress in astronomy, in this curious book, but of course it is a question how much credence is to be attached to it. Their knowledge of eclipses, in particular, appears to have been considerable.

The list of comets, the translation of which constitutes the principal portion of Mr. Williams's work, commences 613 B.C., and comes down to 1222 A.D., by the original compiler, Ma Twan Lin; and it has since been carried on by another author, to 1640 A.D. Astrological predictions are almost universally coupled with the Chinese observations in astronomy, as in our own middle ages. The cometary observations before 613 B.C. are vague.

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The number of comets in the list is 370, but some may have been meteors. Biot's catalogue contains 144 less. The Chinese list may therefore be put forward as one which is as complete as any that has appeared. Some of the original observations give only the year of appearance, others the dynasty, the emperor, the year, month, and day—the path among the stars, and the time it remained visible. The observations are therefore of two kinds—1st, chronological; 2nd, astronomical. Mr. Williams has devoted much labour to the construction of a series of tables from which any date mentioned in the Chinese way may be recovered, and he gave numerous examples of the use of these tables. The epochs are the designations of the years of the reigns of the successive emperors; and great difficulty arises from there being frequently a number of these epochs in the same reign; certain flattering terms being used to describe the years in each reign. The proper names of the emperors, also, were not allowed to be used after their elevation; and upon death certain fresh names were inscribed in the temples. The study of Chinese history is therefore no easy task. The first day of each year depends upon the first day on which the moon enters Pisces, and is therefore variable; and the earliest it could be is January 22 of our calendar. The visible heavens were divided into 31 portions, each deriving its name from one particular asterism. Their boundaries were most irregular, both N. & S. and E. & W. They are so continually referred to that they must be well learnt by anyone desirous of understanding Chinese astronomy. They really consist of 28 stellar divisions and 3 great spaces. Mr. Williams has made tracings of these from the Chinese charts. These divisions are grouped into 7 classes, answering somewhat to our points of the compass. The translation has been made entirely from the original text, without which no definite opinion can be formed as to the epoch, and has involved no ordinary amount of labour. Many thousand characters have had to be translated—the tables constructed to verify the dates, and the atlas copied. How far the work done is valuable must be left to others to say, but it will remain in the library for reference to by those interested in the study of Chinese astronomy; and, if successful, will enable anyone using it to obtain correct information in many important particulars.

The President having retired from the chair towards the close of the paper, being weak from his recent illness, it was occupied during the remainder of the meeting by Warren de la Rue, Esq., F.R.S., Vice-President, who at the conclusion of Mr. Williams's paper tendered to him the thanks of the Society for his very valuable contribution to science, and stated that the author had been engaged three years upon the work which he had recently

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presented. The Council had it in contemplation to place the volume in the hands of the Fellows, by printing it in its entirety, if possible, but as Mr. Williams had placed the original Chinese parallel to his translation, that scholars might judge of its correctness, it might turn out this would be too expensive. At any rate, the introduction and catalogue would be printed and circulated. The Chairman also enquired whether Mr. Airy had any remarks to make upon the subject.

The Astronomer Royal said it could not be too much impressed upon us that Astronomy was a science connecting the past, the present, and the future. In this manner Chinese Astronomy, as affording evidence of what had been done in the past, became a subject of great importance and interest.

The Astronomer Royal, reverting to the subject of the *Correction of Atmospheric Dispersion by means of a Prism*, described at the last meeting, exhibited the finished eye-piece, to which he then referred, and a large sectional model of it, prepared for him by Mr. Carpenter. The eye-piece is an ordinary Huyghenian, in which the plano-convex field glass remains as before, but the similar eye glass can be shifted in its socket by a screw, and thus, when pushed into a slanting position, while the interior surface presents the same curvature, the exterior flat face becomes a prism of any required angle, producing the necessary effect of counteracting the atmospheric dispersion. This was the result of a simultaneous occurrence of the idea to both himself and Mr. Simms, and after interchanging their thoughts on the matter, the contrivance had been carried out as shown. Mr. Airy was also of opinion that it would be valuable for the correction of imperfect centreing, which produced an effect analogous to atmospheric dispersion. He thought, therefore, that no good telescope should be without such eye-pieces, and that "all curious about their eyesight" would adopt them.

The Astronomer Royal further mentioned that he had last night received a brochure and letter by the French post from a French priest (the Abbé Vasseur, he believed) who had made researches on the existence of a planet exterior to Neptune. By a very easy process of reasoning—much easier than that gone through by Adams and Le Verrier—the author had satisfied himself of the existence of this planet, and feeling thus certain, proposed that it should be named Pius IX. (Laughter.)

Mr. Vignolles wished to refer for one moment to the paper by Mr. Williams. Had he rightly understood that Mr. Williams arrived at the conclusion that the early Chinese observations were hypothetical, and not to be depended upon?

Mr. Williams. No: I merely stated that they depended on the authenticity of a certain book.

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Mr. Vignolles. I may say, with respect to my own business, that of engineering—that we have every reason to believe, from an investigation of the Great Canal, that it is by no means of the great antiquity that has been attributed to it, but not more than 1,000 or 1,500 years old. As this was the foundation of a claim to great antiquity for such works in China, may not their astronomy be equally fallacious?

Mr. Stone: I rather understood that Mr. Williams had obtained certain confirmations of the Chinese statements from other astronomical observations. At any rate, it was shown that there were no considerable errors in them. Mr. Williams has also found some records of occultations, which he will translate, and which may be of very great importance; but as I hear the observations merely name the day, they will only be useful to check gross errors.

Mr. Williams: There are no occultations recorded earlier than the 14th century of our era, about A.D. 1360.

On a method of Determining the Orbit of a Planet from Three Observations; by Professor Cayley.

The author gave an oral explanation of this paper, which he said was rather geometrical than astronomical, but sufficiently so to make it fit for offering to the Society. He illustrated his remarks by a model and diagram, showing that an observer, when he sees a planet and knows the earth's position, becomes aware of the direction of the line joining them, and the same is true at the other observations. He also knows that the planet is moving in an elliptical orbit, having the sun in one focus. He then considered the axis of the orbit instead of the plane, and by the figure deduced the required elements.

The Chairman enquired whether Mr. Airy had any elucidation of the practical application of this method to give the meeting.

The Astronomer Royal replied that it hardly allowed of criticism or discussion on the present occasion. He had been much struck with the clearness of Professor Cayley's explanation, but felt that he could not usefully comment on it just now.

A short discussion ensued on the subject, in which Mr. De la Rue, Mr. Stone, Professor Cayley, Mr. Penrose, and Mr. Proctor took part.

On Auroral Appearances, and their Connection with the Phenomena of Terrestrial Magnetism; by Mr. Balfour Stewart.

Some years ago the author suggested that auroras might be produced by secondary currents caused by changes in the earth's magnetism. He had now further elaborated this theory, and referred to the analogy of Rhumkorff's coil, and showed how a change in one conductor, the earth, might produce an aurora in the lower stratum of our atmosphere. This view was con-

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firmed by the results obtained at Greenwich, where earth currents, alternately negative and positive, are developed and studied. The author also referred to Mr. Lockyer's opinion, that the zodiacal light is formed in our atmosphere and is not an appendage of the sun, and suggested that secondary currents are constantly moving from the equator to the poles, which return by the higher atmosphere, where the air, being highly attenuated, is a much better conductor. We know that such rarefied air may be made luminous by electricity, and thus the region of the anti-trade winds may be that of the zodiacal light. As at the equinoxes we have the greatest disturbances of meteorological currents, so we may then expect the currents just mentioned to be most affected by them, and the appearance of the phenomena at those seasons thus accounted for. Besides the great yearly currents, there are other daily variations of the earth's magnetism, caused by the sun, perhaps by its action on these currents in the higher atmosphere. The ocean is a conductor, and its motion in the tides across the lines of the earth's magnetism, though slow, may be the cause of the lunar diurnal magnetic changes. The author thought Mr. Airy had obtained indications supporting this theory, and also suggested that it might account for the correspondence, found by Mr. Baxendell, between the motion of the wind and changes in magnetism. Might not the appearance of an aurora indicate a change of weather coming in? All the phenomena referred to were independent of the connection in period between sun spots and magnetism. In conclusion Mr. B. Stewart invited further consideration and examination of the subject.

The Astronomer-Royal said, that the subject was hardly one belonging to this Society, but he might state that he had established wires dipping here and there into the earth and having galvanometers in their circuit, the indications of which were registered photographically. We find thus, that currents are passing in the earth, and we can tell what magnetic effects we ought to get from these, and compare them with those registered by the magnetic instruments. A correspondence is found in the larger movements, but with this difference, that the effect is generally retarded, the motion of the galvanometer being earlier than those of the magnets. This may be from time being occupied in charging the earth. An important investigation of this subject has been commenced. The disturbed days have been taken first. These are 53 in about 3 or 4 years, and in them the correspondence is universal, but on the greater number of tranquil days it is found that the galvanometer currents are not sufficient to account for the magnetic changes. There must be several causes for the alterations in the magnets.

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The galvanometer currents account for most of the disturbed days. The diurnal variations somehow depend upon the sun. We know the effects of magnetism in the gross and magnetism in its secular changes, but when we come to compare their laws we find ourselves extremely in the dark. They are separate forces in a great degree, but we cannot say what is the law of each. There is no more difficult or worthy problem than the analysis of the forces of magnetism. It is receiving great attention now, but as to mechanical reasoning we are as far off as ever.

On a New Theory of the Milky Way; by Mr. Proctor.

This is an attempt to account for the chief appearances of the Milky Way on a spiral theory. The idea was not new, having been thrown out by the late Professor Nichol, but had been worked out and illustrated with diagrams by the author. He had been induced to take up the subject from finding it difficult to explain the constitution of the galaxy on Sir W. Herschel's cloven disc theory. Sir William had been led to his belief by assuming a sort of analogy to the solar system, and that the stars did not differ much in size and were distributed at much the same distances from one another; but we now knew that things were very different to this. Had he been alive now, with this improved knowledge of the facts, he certainly would not have propounded his hypothesis of the form of the Milky Way, and we were therefore quite free to follow another. The salient features to be accounted for were the strange gaps in the rings—the narrowing in parts, and the Coal Sacks in both north and south hemispheres. Mr. Proctor then proceeded to explain by his diagrams how these appearances would result from a spiral arrangement of the stars not in one plane, which he thought satisfied all the general features of the galaxy, although there might be a few outstanding details. This theory explained Sir John Herschel's brightest part and the vanishing altogether in another portion, and was supported in a certain sense by the spiral nebulæ, whether they were external systems or a part of our own. By analogy, they equally confirmed his view, whatever they might be, and his idea accounted for the aspect of the Milky Way better than the cloven disc of Sir William or the flat ring of Sir John Herschel.

On a Method of Constructing Charts, by which, in a few moments, the Great Circle Course between any Two Points may be accurately ascertained; by Mr. Proctor.

On the November Meteors; by Mr. Tupman.

The meeting then adjourned.

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CORRESPONDENCE.

N.B.—We do not hold ourselves answerable for any opinions expressed by our correspondents.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

THE NOVEMBER METEORS.

Sir,—Astronomy is so little cultivated *out* of the Observatory in Glasgow (from the general cloudiness of the sky, which hides *half* the phenomena in the heavens that are visible at other places), that during Professor Grant's absence in London I have not been able to obtain access to any star-charts of even ordinary pretensions in the libraries. Argelander's *Uranometria Nova* appears to be the solitary possession of the kind in the University Library, and I cannot meet with any other maps of the stars here, elsewhere. I have, therefore, not been able to compare together the several accounts of the large meteor of November 6th which have appeared in print; and two of which were sent to me in letters by good observers in Kent. As I have seen no other description of the meteor's apparent path by the stars from that part of England I send a copy of these letters, premising that the observer at Hawkhurst, Mr. T. Humphrey, mistook his stars in the first instance, and only sent me a correct drawing on my pointing out to him the *impossibility* of the first drawing being even a rough approximation of the meteor's place. I do not know where the star *B. Ophiuchi* is, as it is not in Flamsteed's (the British) Catalogue, which is the only catalogue that I have been able to consult here; but the two observations from Kent at least agree together in placing the meteor's path in *Ophiuchus*. At Bristol Mr. F. Denning observed it in Serpens, and at Stokesay in Shropshire it appeared in Sagittarius. I must write to some more of the observers, as at present the observations by the stars present a most singular discordance!

So far as I have heard, the November meteors were not well seen in England, but about 40 meteors (one very bright) were seen at Leith between 5h. and 6h. A.M. on the 14th, and a somewhat greater number by a member of my mechanical class, here (who mapped about 30 of their tracks), between 4h. and 5h. 30m. A.M. on the same morning. The large fire-ball which he saw 'moving slowly from α Cephei to $\frac{1}{2}$ (β, η) Draconis' had no connection with the Leonides, as he particularly noticed that it 'rose upwards in the north, crossing their direction.' A friend in Paris wrote to me that the nights of the 13th and 14th were cloudy there; so that Mr. Le Verrier's party were perhaps unsuccessful; and we must wait for Italian accounts for a complete description of the shower. There was a very fine auroral arch here on the 25th of last month between 7.30 and 8.45 P.M., extending, almost stationary overhead, from the east to the west horizon, and crossing the stars Algol and Albireo in a straight line. It was not more than 3° or 4° wide, and extremely bright. I was too hurried to examine it in the spectroscope, but I *easily* saw Angström's greenish-yellow line in the spectrum of a bright auroral light at Perth on the 31st of October, with a small pocket spectroscope by Ladd, *about three inches long*. It is a *most brilliant* and striking spectral line; and I could see *no other* spectrum by its side to mix with it.

I remain, Sir, yours truly,

Glasgow: 1869, Nov. 9. A. S. HERSCHEL.

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OBSERVATIONS OF THE LARGE METEOR OF THE 6TH NOVEMBER, 1869.

"A. S. Herschel, Esq. &c.

"Sir,—I was fortunate enough to witness the appearance of a splendid meteor on Saturday evening. I was walking northwards from this place at 6h. 50m., or thereabouts, and a bright light suddenly appearing all around me, caused me to turn, and I saw at that moment a meteor in the act of exploding. I can compare it to nothing so nearly like the explosion of a sky-rocket high up in the air, which on the spur of the moment, and being the time for fireworks, I considered it to be.

"I saw several fragments flying apart, as in the explosion of a rocket; they appeared to be of different colours, some blue, others orange-coloured, and white, and above this spot there was the train of light caused by the motion of the meteor, standing like a slender pillar of fire quite perpendicularly, and reaching to the star Vega. A small luminous cloud, like a 'nebula,' was visible for several minutes at the spot where the meteor had disappeared. The direction from Hawkhurst was nearly west. I particularly noticed the extreme rapidity of the meteor's flight, and its perpendicular direction towards the earth.

"I am, &c.,

"Hawkhurst, Kent, Nov. 7th, 1869. "T. HUMPHREY."

[In a diagram which accompanied this letter, the meteor began at Vega Lyræ, and ended near μ, ζ, Herculis. In a second letter Mr. Humphrey gives the following reconsidered account of its position]:—

"When I observed the meteor I endeavoured to fix in my mind the relative positions of several brilliant stars, and of the Milky Way to the place in the heavens where it appeared. I noticed a streak of light, its downward track,—extending upwards to a tolerably bright star,—and directly above it, at a considerable altitude, was another star brighter than the other. I also observed the Milky Way a little to the left of the point of explosion, and several dim stars also a little to the left of the same spot. When I reached home I consulted a perforated planisphere of the constellations, and fixed on the two stars α Cygni and Vega Lyræ as the two on which I had aligned the meteor; but when I came to see their altitude on the first fine evening after the meteor appeared, I felt sure that I had made a mistake in mentioning Vega Lyræ as the point where the meteor appeared, and that the star to which the streak of light extended was Ras Athagus,—α Ophiuchi,—Vega Lyræ being the one that I had aligned it to. I now feel quite certain that the meteor disappeared a little to the right of $\beta\gamma$ Ophiuchi."

"Sir,—I enclose a slip cut from the *Daily News* [describing the meteor as observed, at about 7 o'clock, at Highclere, Hants]. At the same hour of that evening, the 6th, walking from Ramsgate to Broadstairs, about midway between the two towns, my face being to the N.E., a strong reflection of light from the ground caused me to turn quickly, when I saw in the S.W. what had all the appearance of a brilliant rocket, but *descending* nearly vertical, the inclination from the vertex being about 2° N. In its descent it must have passed over the star B Ophiuchi, that being the position of the stationary train which continued visible over a minute. Not seeing the commencement, I am unable to give so good a description as I could wish, but the bright flash which attracted my notice was but momentary, the body continuing its very rapid motion below the horizon, the whole occupying scarcely two seconds.

"I am, &c.,

"Broadstairs, Kent, Nov. 9th, 1869. "JAMES CHAPMAN."

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[The positions of these observers' places were about,—Hawkhurst, N. lat. 51° 2′, E. lon. 30′; Broadstairs and Ramsgate (halfway between the towns), N. lat. 51° 19′, E. lon. 1° 25′. They were therefore situated very nearly in the direction of the line of sight drawn from either towards the point of the horizon where the meteor disappeared; and the small difference between the observed positions of the meteor at the two places, although nearly fifty miles apart, is sufficiently accounted for by the very similar positions which the places themselves bore to the meteor's real path.]

[We have since received the following further communication from Mr. Herschel]:—

Sir,—In continuation of the description which I sent you, in my last letter, of the appearance of the large meteor of the 6th of last month, as observed at Hawkhurst and near Broadstairs, in Kent, I am now very happy to be able to send you Mr. James Chapman's correction of his observation of the meteor's path at the latter place. His index-star "B Ophiuchi," over which the meteor must have crossed, turns out, as I anticipated, to have been *beta* Ophiuchi; and his observed position now agrees very closely with the apparent path of the meteor as observed at Hawkhurst. I will let his letter speak for itself, of which I enclose a short extract, and I am sorry that I was so busily engaged when it arrived, and have been so constantly occupied with other pressing duties ever since, that I was not able to send it to you on its first receipt. I would also gladly compare it with Mr. W. F. Denning's observation of the meteor's path at Bristol, "from 1½° E. of η Serpentis to R. A. 18h. S. Decl. 10°"; and with Mr. D. La Touche's note of its course at Stokesay in Shropshire, "that the streak was 15° in length, extending in a straight line from α Capricorni to σ (Sigma) Sagittarii, halfway between those two stars;" if I had time to calculate from them the real height &c., of the meteor. As soon as I have a little more leisure, I hope that I will be able to send you the result.

The sky is quite cloudy here this evening, with rain, and a gale of S.W. wind. I looked out at 6 o'clock, during a fine interval of about ten minutes, without seeing any meteors. The moon was shining brightly. Last night, at the same time, there was no meteor visible in half an hour; but a pretty bright display of aurora from 6h. to 6h. 30m., with a low arch in the N.W. and streamers in bunches, and *aigrettes* shooting upwards nearly to Polaris. It ceased at half-past 6 o'clock, having grown higher; and at the same time apparently scattered and diffused itself until it disappeared. From 11h. to 11h. 30m. there were no more signs of the aurora; and without moon and in a clear sky I saw only one meteor in half an hour. The December meteors, this year, have, I am afraid, been very poorly represented. Mr. G. L. Tupman's description of the November meteor-shower at Port-Saïd, near Alexandria, in the *Times* of the 8th inst., is a good proof that the *maximum* occurred on the night of the 13th-14th ult.; and gives a rather vivid account of its brightness, and short duration, in which it resembled the showers of 1866 and 1867; but the numbers seen were evidently *much* less than in those years. M. F. Denza, of Moncalieri, near Turin, writes me that the following numbers were counted, at the Observatory there, on the successive nights:—

12th Nov.,	14h. 17h.	.	145 meteors seen.
13th „	9h. 17h.	.	720 „
14th „	14h. 10m. 17h. 10m.,		99 „

Showing, also, a *maximum* abundance on the same night.

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He has reserved all particular details of his observations to send them to M. Le Verrier, for the "Association Scientifique de France."

I remain, &c.,

Glasgow, Dec. 12, 1869. A. S. HERSCHEL.

Meteor of November 6th, 1869.

Description of the meteor's course, as seen between Broadstairs and Ramsgate, about 2′ south of the N. Foreland Light, by Mr. James Chapman:—

"I send on tracing-paper the appearance of the stars which were above the western horizon in the immediate neighbourhood of the meteor, taken from a sidereal map of which the Rev. Thomas Milner is the author. The star β (*beta*) is the one very near to which the meteor passed, so much so that the south side of the stationary train appeared to my vision to partially cover that star. I have marked the zenith-point, from which is drawn the dotted vertical line; whence it appears, by the double line of the meteor's path, that to me it deviated somewhat from the perpendicular. Its greatest brightness seemed to have occurred at the first appearance; though in the rapid and short descent it appeared to give out a profusion of luminous fragments, which the Hawkhurst correspondent very correctly describes as resembling a rocket. I should also add that my horizon was bounded by trees not very distant, notwithstanding which it certainly appeared to descend below β (*beta*) before exploding. There must have been a very bright ignition, of which I only saw the reflection; the luminous fragments flying off during the descent seemed to indicate a protracted explosion, the end of which I was prevented from seeing by the intervention of the trees."

[The tracing shows the path of the meteor in an almost perpendicular line from a point about three-fourths of the distance from the zenith to β Ophiuchi, passing almost close to that star, and between it and α Ophiuchi, *towards* the horizon.]

On the subject of Meteorites we have extracted the following letters from the *Standard*:—

A STONE CRYING OUT.

Sir,—In your journal of the 18th of November last, there was an account of the fall of a flint meteorolite at Fawley, near Southampton, Hants, in a letter from A. T. Smith, Esq., of that place, which appears to me so remarkable, that, as I have not seen it subsequently noticed by those more directly conversant with geological studies, I venture, if you will permit me, to recall attention to it.

The meteorolites which have been noted hitherto, and recognised as such, have not been of that description. But the origin of the flint formation, consisting of separate balls in stratified layers among the chalk, has been an unexplained mystery. The existence of shells, fossil sponges, and coralines, among the chalk, and even of corals imbedded in flint itself, of which there are specimens in the Museum, indicate that, in such instances, it must have been once under the sea. But as two-thirds of the globe are covered with sea, a large portion of the meteorolites may be believed to have fallen there. If a flint meteorolite, while yet in a soft state (and that which fell at Fawley is thought to have been soft when it reached the ground), fell upon a projecting coral, it would be pierced by it, and so having imbedded it, would probably break it off, and carry it along with it to the bottom. There are appearances which may favour the opinion of the for-

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mation of the flint by intense heat melting and separating the silica from a material containing other substances; the exterior crust of the flint having apparently, like felspar, some substance fused in combination with the silica, and with which it had therefore been in contact. By the intense heat of the meteor, in its fall other portions of the material, divested of the melted silica, might be pulverised and precipitated in chalk dust. The forms of flints are such as agree with their formation, not in cracks or fissures of the earth, like siliceous veins, or by filtration and deposit of silicated thermal waters, but in free space, where they could, and naturally would, assume the globular form, variously modified by occasionally running together, also affected by dropping in a soft or semi-liquid state into undulating water. The effect of rapid cooling by the water, or in some cases collision with rocks, would account for some cleavages and fractured edges, which modify the generally rounded form.

What continuous and severe meteoric showers, like hail and snow-storms, this planet may have been visited with in its earlier physical history we may thus have some indications of. The recent flint fall bears testimony for its species. Detached or sporadic falls might occur later than the general showers; and, having regard to the sharp-edged and pyramidal forms into which I find flint tends to split when it has been exposed to a strong red heat, I incline to think that the broken flints, which have been made so much of as supposed evidences of man's existence in long pre-Adamite ages and of his construction at that time of rude spears and axes, are no more than natural splinters of some large sporadic flint meteorolites. The drawings which Sir Charles Lyell has given of some of them from the valley of the Somme in his "Geological Evidences of the Antiquity of Man," pages 114, 115, impress me strongly with this idea. Sir Charles confesses that their sharp edges have certainly not been obtained in the manner in which any known human savages ever sharpened their stone implements. The evidence supposed to be afforded by them to the extreme antiquity of the human race may thus require revision—if it be not rather placed in the same category with the exploded evidence of the celebrated "Abbeville jaw," for the conclusive confutation of which we were indebted at the time to Dr. Carpenter.

If you can afford space for this letter the message of this new aërial visitor may have some interest for others, as it has had for me.

I am, Sir, your faithful servant,

1 Fitzroy-road, N. W. W. B. GALLOWAY.

Dec. 4, 1869.

Sir,—How far the fact of a flint aërolite having fallen at all will bear scientific investigation, I know not. The assertion that such has been the case is so extraordinary that I trust the matter will be looked into by properly-qualified persons. At present we can receive the report with the utmost hesitation—not that we have any doubt, of course, in the veracity of the narrator, but because we think he may have been deceived.

Your correspondent Mr. W. B. Galloway, can, I should imagine, have very little acquaintance with the flint formation, even as far as it is illustrated by the common flint stones in the roads of the suburbs of London. He remarks that flint naturally takes a globular form, and was not deposited in clefts or fissures of the earth; nor, thirdly, by filtration and deposit of silicated thermal waters; and, lastly, that it probably dropped in a soft and semi-liquid state into water, which would account for the cleavages and fractures which occur in some flints. This last can be dismissed with a word or two. If flint was ever split in the manner suggested, no doubt such

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would be the general rule—in fact, most flints, all having a similar origin and being deposited under similar conditions, would be so cleft and cracked; but flint nodules are always solid and unbroken, unless the strata in which they occur have been disturbed—the greater the disturbance the greater the amount of fracture; so that at White Cliff, in the Isle of Wight, where the lines of flints are almost vertical, being situated, as it is, close to the point of upheaval, in the centre of Sandown Bay, where the wealden is exposed, the flints, though apparently perfect, upon a touch of stone or hammer immediately fall into fragments.

Your correspondent's first instance also militates against cleavage by sudden cooling, for if it cooled so suddenly as to be split as described, it could not have surrounded, in its passage through the waters, sponges, corals, shells, or the like. But the ordinary appearance of flints in a highly fossiliferous chalk precludes the possibility of there being any truth in this theory. We do not find one or more corals being struck in the descent, and so adhering, but flint running into and so pervading the finest and most intricate organisms. We find the mass of flint covered on all sides with remains of all such things as grew at the bottom of the sea where they were deposited, even the impress of sea-weeds, coralines, small and large shells, echinoderms with their spines entire, and so doubtless at the bottom of the sea.

That flint naturally takes a globular form is not a fact, for it is found of every conceivable shape, none being more common than that of a long, irregular, cylindrical form—doubtless in innumerable instances the form was determined by the organic matter which formed the nucleus round which it collected. But it is not by any means universally found in disjoined masses. It often is found in "fissures and cracks." It is frequently to be seen about Ramsgate and the coast of that neighbourhood, for example, running down the cleavage of the chalk, in thickness varying from an inch and a half to the thinness of a piece of Bristol board. This would seem to show that, as far as this flint is concerned, its formation took place subsequent to the cleavage. Again, between Ramsgate and Broadstairs, for miles in length, and of indefinite extent inland, there is tabular flint of extraordinary thickness, ranging from two to nine or ten inches in thickness. I need not say that it is physically impossible that this could have been due to aërolites. It might have flowed in like lava possibly, but the preservation in it, as in all flints, of the most delicate natural objects, I think, proves that the amount of heat which caused the absolute liquefaction of flint to a tenuity so subtle as to permeate in the most perfect manner the beautiful choanites, favosites, sponges of all kinds (as we find especially in beautiful chalcedony, which forms the centre of so much of the Isle of Wight and Sussex flints), could not have been any heat approaching to that of lava, or even red hot metal. This is, doubtless, also proved by the tiny delicate shells found sticking to and embedded in the ordinary flints.

In fact, nothing but filtration of silicated thermal waters will account for the preservation of the exquisite specimens of branching sponges and choanites, and the like, which we find in chalcedony, in the centre of any of the larger flints, even of the gravel beds round London, especially the north-east —in fact, such specimens as, when denuded of their flint coverings by rolling in the sea, are picked up as pebbles at Brighton or Sandown.

In conclusion, I assert that no flint fracture has ever been observed that was not due to mechanical force, either caused by alteration of position, natural cleavage, or the like, and offer for the consideration of your readers the following facts connected with the subject, and disproving any possibility of flint dropping from the sky and cooling as it went down through the water.

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1. Flints enclosing delicate organisms, partly or wholly permeated with chalcedony.

2. Flints less perfectly themselves permeating such substances, and enclosing perfect echinoderms, spines and all.

3. Common flint filling up, as lead or iron poured into a mould, echinoderms and shells of all sorts, large and small, in the case of echinoderms a drop just oozing out at the vent-hole—the said flint containing innumerable fragments of sponge spicula, spines, and other marine objects.

4. Flint forming in thick or thin horizontal tables, and actually running down the natural chalk cleavage, unless possibly the instances I have noticed are thin tabular flint which was once horizontal, though I think not myself.

If your correspondent had not wished to support a theological theory, I think he would not have ventured upon another theory, which has not even possibility to recommend it.

Your obedient servant,

Hackney: Dec. 11, 1869. J. C. JACKSON.

PENUMBRA OF THE SHADOW OF JUPITER'S SATELLITES.

Sir,—In the 2nd vol. of The Student, at page 217, there is an interesting article by Mr. Proctor on Jupiter's Satellites, in which a figure is given of the shadows of each of them, with a statement that "the shadows have not indeed been *seen* as here shown, no telescope yet constructed having sufficed, it would seem, to exhibit the penumbral band surrounding the true shadow as a distinct feature." At page 219 an account is given of some observations made on the 21st of August 1867, by various parties, some using reflectors and others refractors. The 4th on the list is an observation "by Mr. Joynson (with a 6-inch lens); a sort of border could be seen round the shadows of the third and fourth satellites, but none round that of the first." "This observation is the only one I have met with in which the penumbra of these satellites' shadows have been spoken of as distinguishable. Mr. Dawes, looking expressly for the phenomenon (in the case of the 4th shadow), failed to notice it. So also did Mr. Barneby."

I have just lately seen an article in the Monthly Notices of the R.A.S. vol. 10, page 116, by Mr. Lassell on "Observations of the Phenomena of Jupiter and his Satellites," in which, at page 117, he says "The shadow of the satellite (3rd) seems to have a penumbra." This observation was made on the 12th of March 1850, and has doubtless escaped Mr. Proctor's notice; but as it is confirmatory of the latter observation, I am induced to call your readers' attention to it, in the hopes that as Jupiter is now favourably situated, and has been so for some time past, some efforts may be made to observe the same satellite's shadow, and, if any penumbra or border is noticed, that such observation should be recorded.

Dec. 14, 1869. VIATOR.

[The following extract from the Editor's Note-book, with reference to this subject, may be of interest:—

Extract.—Downs Road, 1861, February 28, 12h.: "Observed a dark spot on the planet, and knowing that the 3rd satellite would cross the disk some time during the evening, I concluded it to be the *shadow* of the satellite. I was therefore surprised, when looking again about 14h., to observe the shadow just then well on to the following limb of the planet, the spot I had taken for the shadow being really the satellite. The shadow

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was nearly twice as large and much darker than the satellite, and had a shade or appearance round it like the penumbra of a solar spot, which it somewhat resembled."

March 29, 7h. 35m: "I again observed the shading off of the shadow of the 3rd satellite, giving the appearance of a penumbra."

See also, "Celestial Objects," by the Rev. T. W. Webb, second edition, page 140.

These observations were made with my usual refractor by Ross, of $3\frac{3}{8}$-in. aperture, the excellent definition of which may be judged of from the fact that on the 15th April 1862, at 11h. 40m., I saw with it, using a power of 100, the shadow of Titan distinctly and beautifully on the disk of Saturn.—Ed.]

THE OBSERVING ASTRONOMICAL SOCIETY.

REPORT OF OBSERVATIONS MADE FROM SEPTEMBER 7 TO NOVEMBER 6, 1869, INCLUSIVE.

Jupiter.

Sir,—Mr. T. G. E. Elger, of Bedford, observed this planet on several occasions during the above period, and the following are the results he obtained:—

"Sept. 25, 9h. 30m. to 10h. 30m.: I noticed that the space between the central belts was peculiarly ruddy, and that there was much detail in the upper equatorial belt, which showed a bifurcation." A spot was visible on it "nearly as dark at 10h. as the shadow of Sat. II. which was on the disc."

"October 6, 9h. 30m. to 10h. 10m.: The general appearance of the planet was unaltered except the southern large belt, which now consisted of two belts close together; the ruddy colour between the two central belts had increased in intensity, and white modules were noticed surrounding the dark spots below the upper large belt. The drawing fig. 1. is a copy of a sketch made at the telescope."

"October 9, 10h. to 10h. 30m.: The belts were splendidly defined; the ruddy colour still more intense. I noticed four projections" from the lower part of the upper large belt. These projections were edged with light.

Mr. Thos. Whitehouse examined the planet on October 8th, at 11 P.M., with his $12\frac{1}{2}$-inch refractor. He says, "The disc was nearly covered with belts." In the sketch enclosed with his letter the belts appear to be very numerous, especially near the pole of the planet.

Mr. H. Ormesher writes as follows:—

"September 22, 5.15 A.M.: I observed three dusky spots on the disc of the planet Jupiter. They were situated on the upper large belt, and seemed to convey the impression that his atmosphere was much disturbed.

"September 25, 10h. 30m.: I noticed the belts were more numerous, and one of them, situated just above the planet's equator, was very irregular and somewhat darker. The ingress of Sat. II. was observed, but nothing unusual was noticed."

On October 26th, at 9h. 15m., Mr. A. P. Holden "observed the markings on the planet; two broad and dark belts near the equator, with another belt above them. The two former were attached by a well-defined sloping band towards the E. side; below these towards the S. another well-defined belt was visible, stretching about one-third across the disc, this one being

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broad where it touched the planet's edge, and gradually tapering off as it approached the centre. At 10h. 35m. this belt was visible right across the disc, and was quite broad and dark, having thus moved two-thirds across the face of the planet in 1h. 20m."

On the 1st of November, at 7h. 55m., I carefully observed the planet with my 4¼ refractor. Two dusky spots were distinctly seen near the upper large belt. Three belts were very conspicuous and well defined. The space between the two large belts was very dark, while that between the central belt and the northern one was particularly bright. The sketch (fig. 2.) represents the appearance of the planet at 7h. 55m.

The Sketches of Jupiter.

Fig. 1.	Oct.	6	9h. 30m.	T. G. E. Elger, Bedford,	4-in. refractor.
Fig. 2.	Nov.	1	7h. 55m.	W. F. Denning, Bristol,	4¼-in. „
Fig. 3.	Nov.	24	10h. 0m.	T.W. Backhouse, Sunderland,	4¼-in. „

The planet is represented as seen through an inverting telescope.

Venus.

Mr. Thos. Petty, of Deddington, examined this planet at 3 p.m. on the 26th October. "Her northern cusp appeared very blunted, and the southern one slightly so. Her morning crepusculum was just visible." There were also two small cloudy patches visible on the disc of the planet.

Lunar Observations.

The Crater Plato.—Mr. T. G. E. Elger examined this object with his 4-inch refractor, power 200, on September 20, from 9h. to 10h. He "could make out without difficulty" 7 specks in the interior of the crater. On September 25, at 10h. 45m. he "saw all the specks noted on the 20th and one in addition." He continues, "I did not see this on the 20th, although it is usually an easy object. On referring to my observation book, I find that on September 24th, 1866, 9h. 30m. to 10h., I have shown a speck nearly coincident with No. 19 in Mr. Pratt's diagram, but I cannot be certain of its existence, as I neglected to refer it to other objects. I have, therefore, seen altogether, 9 specks on the floor of Plato: 8 were seen at the same time on September 24th, 1869."

Solar Spots.

Mr. T. W. Backhouse, of Sutherland, writes that a large cluster of spots was visible on the 7th of September. "At 9 a.m. the greatest diameter of the penumbra of the largest spot was 18,500 miles; its nucleus 9,500 miles long and 6,500 miles wide."

Mr. Elger says, "The disc of the sun has not been free from visible spots since the end of August, but I have noticed nothing worthy of record. The spots, with one exception, have been small and uninteresting. Between September 3rd and 11th a large group was visible, which extended over a space of 2′, but which was in no other respect remarkable."

Aurora Borealis.

Mr. H. Michell Whitley, of Truro, says, "There was an Aurora Borealis visible here on October 6th. I first saw it at about 7h. 15m., when it seemed at its brightest. It was visible in the N.N.W. portion of the heavens, and was of a rosy hue. Its apex reached to about 36 Ursæ Majoris, but after the above time it slowly travelled eastward until its highest point was at β Ursæ Majoris. There were three parallel beams of light of a deeper rose tint than the rest. About 7.30 I found the rays did not attain so great an altitude, and had altered to a pale yellow tint. I did not observe it afterwards." This phenomenon was also seen by

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Mr. Ormesher, at Manchester, who states, "The rays of light extended to an altitude of 45 degrees."

Meteors.

Mr. T. W. Backhouse observed 10 meteors on the night of the 4th, but "could not be certain of a radiant point." On November 6th, at 6h. 45m., a meteor of great brilliancy was visible. I fortunately observed it, although not looking towards the sky at the time of its appearance, but did so on finding there was a sudden illumination, which I at first thought was caused by the bursting of a rocket, when I immediately perceived a very large meteor gliding swiftly down the sky. Its duration could not have exceeded two seconds, during which time the whole of the sky was brilliantly illuminated. I did not witness its disappearance, but judging from the train left I imagine that it occurred near R.A. 18h. and S. Declin. 10 degrees. The meteor passed about 1½ degrees to the east of the 4th mag. star η Serpentis, and was of a blue colour. It left a train of light which remained visible to the unaided eye fully 15 minutes after the meteor itself had disappeared. This train gradually became shorter and broader, and drifted towards the star η Serpentis. At 6h. 52m. it presented the appearance of an ill-defined cometary patch, and was apparently attached to the above-mentioned star. At 7h. it became invisible, having drifted into that portion of the milky way near the head of Taurus Poniatowski.

On the nights of the 13th and 14th November the weather appears to have been very unfavourable for the observation of meteors. At Bristol the sky was completely overcast during both nights.

Parhelia and Paraselene.

Mr. T. P. Barkas, of Newcastle-on-Tyne, observed a Paraselene on the evening of the 17th of October. On the afternoon of the same day at 4 P.M. a Parhelia was also perceived at the same place. An artist who resides at Newcastle observed both these phenomena, and has forwarded sketches of their appearance to Mr. Barkas. In the case of the solar phenomenon there is a representation of a mock sun on the left at a distance from the sun of about 20 degrees, and a fainter image of the sun on the right. On the evening of the same day he "saw the moon with a ring round it, and on the E. and W. sides of the ring a spectral moon; radii at right angles to each other crossed the circle, and formed a kind of luminous Maltese cross."

I am, Sir, truly yours,

WILLIAM F. DENNING, HON. SEC.

Ashley Road, Bristol.

THE GREAT MELBOURNE TELESCOPE.—The result of the first working of this instrument, which is now at the antipodes, is not so satisfactory as when it was tested at Messrs. Grubbs' at Dublin. Sir E. Sabine thinks this may arise from imperfect knowledge of the principles of construction, and inexperience in the use of so large a telescope; also partly from alterations made at Melbourne, or from atmospherical causes; still the original condition might be restored. The nebula surrounding η Argus had been examined by its means in June, and great changes seemed to have taken place since it was described in 1834 by Sir John Herschel. A strong probability is suggested that "this nebula is *much nearer* to us than the stars which are seen along with it." The photographic and spectroscopic apparatus for the telescope have arrived safely at Melbourne.

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PROFESSOR DONATI'S LECTURE ON SOLAR PHENOMENA.

Continued.

From these notices of the progress of this branch of science it appears that the idea has prevailed for a long time that there are some relations and resemblances between solar and planetary phenomena, and that not a few facts lately discovered concur to demonstrate the truth of such an idea. And, to my mind, to consider the solar phenomena as depending upon, and produced by, electricity, is one of the most natural and simple modes of conceiving them. . . . The community of origin, and, so to say, relationship of the sun and the earth is proved by spectroscopic analysis, and it is natural to suppose that a still closer analogy exists between our own and other planets; so that as electric currents exist on the surface of the earth, similar currents may exist also on the surface of the other planets, and on that of the sun. Those of our globe arise specially from changes or disturbances suffered by the distribution of caloric in the terrestrial mass, and, whilst equilibrium is being restored, those phenomena often acquire such characters as to cause the earth to emit a light of its own, as happens when auroræ boreales are developed. . . . It has been found that Venus, which shows phases like the moon, often appears covered with a phosphorescent light in that part not enlightened by the solar rays, which leads us to think that there are auroras in that planet like ours; and if electricity infuses light on the earth and the other planets, why may it not also give it to the greater star?

The interior matter of the sun, like that of our own globe, is quite unknown to us; we merely know that the former has a mean density equal to that of water, and it is probable that it is more dense towards the centre, and not everywhere homogeneous or uniformly distributed. Consequently the constant radiation to which the sun is subjected must greatly disturb the distribution of caloric, whence arises a development of electricity, which, in its turn, is a perennial source of fresh heat and light. The forces of nature continually act and re-act on each other, and are transformed by turns in a periodical and endless cycle. The force which, in the vast celestial spaces, is universal attraction, becomes gravity on the surface of the earth and of the other planets, and is changed into a force of adherence, of cohesion, of affinity, in a word, into all the varieties of molecular forces, when it acts at very small distances on the first elements of matter. The heating force which the sun diffuses through infinite space, when it comes to be confined in the bowels of the earth is changed into that force which the magnet obeys, like the nymph of the fable, who, repulsed by Phœbus, was changed into the sun-flower:—

. . . . Illa suum, quamvis radice tenetur,
Vertitur ad solem, mutataque servat amorem.*

In this manner all motions are produced, whence arises heat, then electricity, magnetism, light, and, in a word, the entire life of the universe.

In face of this marvellous spectacle of unity amidst variety is it not, therefore, natural to suppose that, as the earth becomes luminous by the auroras, so not very dissimilar and more powerful causes continually render the surface of the sun hot and luminous, in the same manner as our electric currents render platinum, and any other body which is a bad conductor of electricity, incandescent when they traverse it?

Here I will cite a fact which, however hitherto isolated in science, is nevertheless most certain, and which seems to me to prove that electric

* Ovid, *Metam.* iv. 269. *She, though held by the root, turns to her beloved sun, and, changed, yet keeps her love.*

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phenomena really occur in the sun. On the 1st September 1859, while Mr. Carrington was engaged in drawing a great spot then visible, he observed two large streaks, as luminous as the photosphere, suddenly to appear and project themselves on the dark ground of the large spot; the smaller of these luminous masses was as large as the surface of a section made by a plane passing through the centre of our earth; and the larger was equal to the surface of a section similarly made in Jupiter; but their figures changed very much from the instant of first appearance to their complete disappearance. They remained visible five minutes, in which time they changed much in position, each having traversed a space not less than 56 thousand chilometres; they then disappeared, leaving no trace behind. Fortunately, at the same time, Mr. Hodson in another place, was observing the sun, and he too, independently of Mr. Carrington, announced that he had seen the above-described phenomenon.* It has all the appearance of having been produced by a development of electricity in the regions of the solar atmosphere, which corresponded with the great spot which was then visible. Precisely at the time in which the luminous marks were seen, a very notable disturbance, although of short duration, was manifested in the magnetic needles at Kew; and 14 hours afterwards there was a great magnetic storm in both hemispheres; and the same day, and on the following days, auroræ boreales were observed. Although Mr. Carrington rightly observes that we must not be too hasty in attributing over much importance to the coincidence of these phenomena, since one swallow does not make spring, it cannot be denied that their simultaneous occurrence can scarcely be ascribed to what men, in order not to confess their ignorance, have called *chance*. If, now, we marvel that an electric signal made in one point of the earth can at the same time correspond with another terrestrial point diametrically opposite to the first, how much more must we wonder at seeing that phenomena which happen in the sun have immediately their correspondents in the planet inhabited by ourselves!

It is certain that our auroras are in relation with the vapours and clouds of our atmosphere. Near the place where their light appears is always found vapour in the vesicular state, which, during the auroras, tends to gather together and condense itself. According to Humboldt, our auroras are simply a phase of a meteorological phenomenon. If then, the light of the solar photosphere arises from causes more powerful than, but in some way similar to, those from which our auroras are derived, there must also, in the dense atmosphere which undoubtedly surrounds the sun, happen agglomerations and condensations of vapour capable of producing very great clouds; and the spots may not be anything else than those clouds projected on the photosphere. After attentively reading the description by Carrington and Hodson of the phenomenon observed by them, I think if I had had the fortune also to have witnessed it, I could not have described that great spot in which such a quantity of light ran with immense velocity better than by repeating, with the poet,—

> Par che baleni quella *nube* ed arda
> Come di fiamme gravida e di lampi.†

The opinion already put forth by Galileo, that the solar spots are clouds, and that they have a meteorological origin, is not only, to my thinking, very well fitted to explain their movements and appearances, but, above all, agrees with the now unquestioned fact, that their number, size, and position depend upon external causes. And in fact, we see that our own clouds

* Monthly Notices of the Royal Astronomical Society, vol. xx. pp. 13–16.

† "That cloud seems to lighten and to burn as though pregnant with flames and flashes."—Tasso, Gerus. Lib. cant. iii. ott. 9.

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also, and those of Jupiter, Saturn, and Mars depend as well on external causes, amongst which those which are derived from the sun are so powerful that, in comparison with them, it is impossible to recognise, separately and certainly, those which, perhaps, in the case of each planet, arise from all the others. If this be so the sun must also in its turn feel the influence of its planets, the which (if, as well as it, they are electro-magnetic bodies) according as they are found, either near or far off, or on one side or the other, may modify its electric state at one time in one way, at another in another; and consequently the meteorological phenomena which happen there will also be modified.*

(*To be continued.*)

SPECTROSCOPY.—The bequest of the late Benjamin Oliviera to the Royal Society of 1,300*l.* is to be expended in a telescope of great power, for the purpose of extending this branch of science. The telescope is to be adapted for use either as a reflector or a refractor, and will in the first instance be lent to Mr. Huggins. It is being constructed by Messrs. Grubb & Son; the object glass is of 15 in. aperture and 15 feet in focal length; this achromatic can be replaced, when desired, by a reflector of 18 inches aperture.

BRILLIANT METEOR.—In a letter to the *Times*, Mr. Rickett, H.C.S., describes a meteor which burst forth at 6h. 13m. 30s. G.M.T., nearly due east, about 4 or 5 degrees above the horizon; it took a westerly course, making a gentle curve or arch under the plane of Ursa Major. The greatest altitude was 18 or 20 degrees. After being visible for 15 or 20 seconds it broke up like a rocket. It was as large as Venus, of an intensely bright blue colour, and surrounded by a prismatic halo. It was observed at Cotterstock, Oundle, Northamptonshire.

PROGRESS OF ASTRONOMY IN ITALY.—The following extract from the *Gazetta di Messina* of the 29th November, is published without comment in the *Opinione* of the 6th December: "Yesterday evening, towards seven o'clock, a strong shock of earthquake was felt, which lasted about eight seconds. Contemporaneously a star was observed in the sky whose luminous disk at one moment increased in size, at another diminished, and at another was completely eclipsed. Popular fancy did not fail to see a secret correspondence between that star and the earthquake. The star was, however, merely the planet Jupiter, which, after twelve years' absence, comes to make its accustomed visit to our hemisphere."

LILIAN'S HAPPY HOURS is the title of a little Book published by the Religious Tract Society, in which in nine chapters Lilian's mamma tells her all about the sun, moon, stars, constellations, &c. It is neatly got up and illustrated with wood-cuts printed in blue; a pretty present for an enquiring child.

CATALOGUE OF STARS.—Would any one oblige me with the loan, for a short time, of the following: 1. *Tabulæ Long. ac Lat. Stellarum, &c.*, Ulugh Beighi, by Thomas Hyde, Oxford, 1665; or its reprint by Dr. G. Sharpe, 1767.—2. Thirteenth volume of the Memoirs of the Royal Astronomical Society, containing Ulugh Beg's Catalogue, by Baily? Great care would be taken of them, and cost of transmission of course paid.

G. J. WALKER, Teignmouth, South Devon.

* MM. De La Rue, Stewart, and Loewy, in the Memoir above cited, p. 78, also say that the influence of external causes on the solar spots can well be comprehended by assigning to those a *meteorological nature*.

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ASTRONOMICAL LIBRARY.—A correspondent of a contemporary enquires how he may best invest four or five pounds in purchasing books on astronomy, including the best elementary and advanced treatises, both theoretical and practical. He wants a good working library, with the means at hand of knowing all that has been discovered, which can be observed with an 8½ inch reflector. As the answer to this question may be very useful to many who are taking up the science, we should be glad if those of our readers who have given thought to the subject would send us their ideas as to how five pounds may be best laid out for the purpose in question.

TEMPEL'S COMET.

We have received the following from the Greenwich Observatory:—

Observations of Tempel's New Comet at the Leipzig Observatory by M. VOGEL.

1869.	Leipzig M.T. h. m. s.	Apparent R.A. h. m. s.	Apparent N. Declination. ° ′ ″
Nov. 29	7 55 7	22 56 27·64	15 25 35·8
	10 11 35	22 57 1·80	15 28 41·5

The Comet is very faint, diffused, but round, and about 2′·5 in diameter.

Altona, 1869, December 1.

THE PLANETS FOR JANUARY.

AT TRANSIT OVER THE MERIDIAN OF GREENWICH.

Planets	Date	Right Ascension h m s	Declination ° ′	Diameter	Meridian Passage h m
Mercury	5th	20 4 9	−22 27½	5″·4	1 4·5
	20th	21 24 42	15 0	7″·4	1 25·8
Venus	5th	22 8 54	−11 26½	32″·8	3 8·9
	20th	22 41 17	5 39	40″·8	2 42·2
Jupiter	5th	2 35 38	+14 6½	41″·2	7 34·9
	20th	2 37 10	14 18	39″·1	6 37·4
Uranus	5th	7 27 42	+22 25	4″·2	12 26·1
	20th	7 24 56	22 31	4″·2	11 24·4
Neptune	5th	1 4 30	+ 5 4½	—	6 4·0
	20th	1 5 0	5 8½	—	5 5·5

OCCULTATIONS OF PLANETS AND STARS BY THE MOON IN 1870.—The largest stars occulted by the Moon this year will be ζ Tauri and δ Geminorum, of the 3½ magnitude. The planet Saturn will be occulted three times, and the planet Uranus once in the course of the year.

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ASTRONOMICAL OCCURRENCES FOR JAN. 1870.

DATE		Principal Occurrences		Jupiter's Satellites		Meridian Passage
		h. m.			h. m. s.	h. m.
Sat	1		Sidereal Time at Mean Noon, 18 43 44·4	1st Tr. E.	4 32	Jupiter —
		12 5	● New Moon	2nd Ec. R.	4 53 20	
				1st Sh. E.	5 41	7 50·7
Sun	2	12 6	Conjunction of Moon and Mercury, 2° 29′ S.			
		18 19	Conjunction of Moon and Mars, 1° 8′ S.			7 46·7
Mon	3					7 42·8
Tues	4		Meridian passage of the Sun, 5m. 15s. after Mean Noon	3rd Tr. I.	10 11	
				„ Tr. E.	12 20	7 38·8
				2nd Oc. D.	13 30	
Wed	5	4 37	Conjunction of Moon and Venus, 2° 53′ N.	1st Oc. D.	12 28	7 34·9
Thur	6	9 52	Conjunction of Mars and Mercury, 0° 52′ S.	2nd Tr. I.	8 6	
				1st Tr. I.	9 42	
				2nd Tr. E.	10 28	
				„ Sh. I.	10 30	
				1st Sh. I.	10 55	7 31·0
				„ Tr. E.	11 55	
				2nd Sh. E.	12 52	
				1st Sh. E.	13 8	
Fri	7			1st Oc. D.	6 56	Moon —
				„ Ec. R.	10 19 45	4 34·8
Sat	8			3rd Ec. D.	5 5 39	
				2nd Oc. R.	5 6	
				„ Ec. D.	5 12 36	
				1st Sh. I.	5 24	
				„ Tr. E.	6 23	5 16·6
				3rd Ec. R.	6 52 57	
				2nd Ec. R.	7 29 10	
				1st Sh. E.	7 37	
Sun	9	9 2	☽ Moon's First Quarter	1st Ec. R.	4 48 40	5 57·9
		21 5	Opposition of Uranus			
Mon	10					6 39·5
Tues	11	1 42	Conjunction of Moon and Jupiter, 4° 21′ N.	3rd Tr. I.	13 55	7 22·4
Wed	12			1st Oc. D.	14 20	8 7·4
Thur	13			2nd Tr. I.	10 38	
				1st Tr. I.	11 34	
				„ Sh. I.	12 51	8 55·1
				2nd Tr. E.	13 0	
				„ Sh. I.	13 9	
Fri	14	20 59	Conjunction of Mercury and θ Capricorni 5m. ·3 W.	1st Oc. D.	8 48	
				„ Ec. R.	12 15 44	9 45·9
Sat	15			2nd Oc. D.	5 13	
				3rd Oc. R.	5 55	
				1st Tr. I.	6 2	
		9 52	Occultation of 15 Geminorum (6)	„ Sh. I.	7 20	
				2nd Oc. R.	7 36	
		11 2	Reappearance of ditto	„ Ec. D.	7 48 17	10 39·8
		10 2	Occultation of 16 Geminorum (6)	1st Tr. E.	8 15	
				3rd Ec. D.	9 7 39	
		10 58	Reappearance of ditto	1st Sh. E.	9 32	
				2nd Ec. R.	10 5 2	
				3rd Ec. R.	10 55 6	

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DATE		Principal Occurrences		Jupiter's Satellites		Meridian Passage
		h. m.			h. m. s.	h. m.
			Sidereal Time at Mean Noon, 19 42 52·8			Moon
Sun	16	7 41	Occultation of 56 Geminorum (5½)	1st Ec. R.	6 44 39	11 35·8
		8 45	Reappearance of ditto			
		13 41	Conjunction of Moon and Uranus, 1° 18′ N.			
Mon	17	2 45	○ Full Moon			
			Eclipse of the Moon, beginning about Noon. See notice	2nd Sh. E.	4 51	12 32·7
		19 35	Occultation of δ Cancri (4)			
		20 15	Reappearance of ditto			
Tues	18	1 49	Greatest brilliancy of Venus			Jupiter
			Greatest easterly elongation of Mercury, 18° 41′			6 44·9
Wed	19					6 41·2
Thur	20			2nd Tr. I.	13 12	6 37·4
				1st Tr. I.	13 27	
Fri	21			1st Oc. D.	10 42	6 33·7
Sat	22			3rd Oc. D.	7 35	6 30·0
				2nd Oc. D.	7 44	
				1st Tr. I.	7 55	
				„ Sh. I.	9 15	
				3rd Oc. R.	9 50	
				2nd Oc. R.	10 8	
				1st Tr. E.	10 8	
				2nd Ec. D.	10 23 59	
				1st Sh. E.	11 27	
				2nd Ec. R.	12 40 57	
Sun	23	22 23	☾ Moon's Last Quarter	1st Oc. D.	5 11	6 26·3
				„ Ec. R.	8 40 40	
Mon	24			1st Tr. E.	4 36	6 22·6
			Meridian Passage of the Sun, 12m. 22s. after Mean Noon	2nd Tr. E.	4 53	
				„ Sh. I.	5 7	
				1st Sh. E.	5 56	
				2nd Sh. E.	7 30	
Tues	25	16 13	Occultation of 49 Libræ (5½)			6 18·9
		16 58	Reappearance of ditto			
Wed	26			3rd Sh. E.	5 12	6 15·3
Thur	27	14 1	Conjunction of Moon and Saturn, 1° 43′ S.			6 11·6
Fri	28	10 32	Conjunction of Mars and Mercury, 3° 52′ N.	1st Oc. D.	12 37	6 8·0
Sat	29			1st Tr. I.	9 50	6 4·3
				2nd Oc. D.	10 18	
				1st Sh. I.	11 10	
				3rd Oc. D.	11 33	
				1st Tr. E.	12 2	
				2nd Oc. R.	12 42	
				„ Ec. D.	12 59 44	
Sun	30			1st Oc. D.	7 6	6 0·7
				„ Ec. R.	10 36 41	
Mon.	31	3 41	● New Moon	1st Tr. E.	6 31	5 57·1
		10 28	Conjunction of Moon and Mercury, 5° 1′ N.	2nd Tr. E.	7 31	
				„ Sh. I.	7 46	
		20 45	Conjunction of Moon and Mars, 0° 58′ N.	1st Sh. E.	7 51	
				2nd Sh. E.	10 9	

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TOTAL ECLIPSE OF THE MOON.—A total eclipse of the moon will take place on Monday, the 17th of January, but unfortunately for observation here, the moon does not rise until the eclipse is nearly over. The end of the total phase takes place at 3h. 35m.; the last contact with the shadow at 4h. 36m.; the last contact with the penumbra at 5h. 37m.: the moon will rise at Greenwich slightly eclipsed, and obscured by the penumbra.

LIST OF SUBSCRIBERS—Name received since our last number.

Williams, Professor Monier, Merton Lea, The Parks, Oxford.

ASTRONOMICAL REGISTER—Subscriptions received by the Editor.

To December 1869.
Lawrence, E.
Richard, J. E.
Webb, Rev. T. W.
Yeates, Miss
Yeates & Son

To January 1870.
Williams, Prof. M.

To March 1870.
Birmingham, J.

To June 1870.
Main, Rev. R.
Squire, H.

To August 1870.
Leigh, J.

To September 1870.
Burlingham, R.

To December 1871.
Compton, A. S.

To December 1870.
Baldelli, Mdme.
Cunningham, G.
Hall, Rev. R.
Herschel, Lieut. J.
Joynson, J.
Knothe, A.
Tidmarsh, Rev. J. B.
Vallack, Rev. B.
Walker, G. J.
Williams, G.

December 21, 1869. Subscriptions received after this date in our next.

ERRATA.—By an error of the printer's, the paging 245, 6, 7, and 8, was repeated. An explanation will be given with the Index, to prevent confusion arising from this mistake.

In the lecture by Donati, p. 240, No. 83. Note, for *Marca* read *Marco*; p. 241, line 23, for *Genoa* read *Geneva*; p. 242, line 12 from bottom, for *single* read *simple*; same page, line 7 from bottom, for *Hausteen* read *Hansteen*.

NOTICES TO CORRESPONDENTS.

NOTICE.—The supplementary number for 1869 is delayed for the completion of the Index for Vol. VII., which is now nearly ready, and will be delivered with it.

TO OUR READERS AND SUBSCRIBERS.

At the commencement of another volume of the *Astronomical Register*, the Editor is desirous of returning his grateful thanks to his subscribers for their kind expressions with reference to his late illness, and for their forbearance during the unavoidable irregularity in the issue of the publication thereby caused. He is thankful to say that his health is now, to a great extent, restored, and trusts to be able to make such arrangements that the *Register* may be carried on with greater efficiency than heretofore. He would wish, also, to express his obligation to those who have assisted him by a regular payment of their subscriptions, and at the same time to remind others, who have not yet remitted for 1869, that a small publication like the *Astronomical Register* can ill afford to give credit; a prompt payment of subscription greatly facilitating the labour of those who conduct a work of this character.

The Astronomical Register is intended to appear at the commencement of each month; the Subscription (including Postage) is fixed at **Three Shillings** per Quarter, *payable in advance*, by postage stamps or otherwise.
The pages of the *Astronomical Register* are open to all suitable communications. Letters, Articles for insertion, &c., must be sent to the Editor, Mr. S. GORTON, *Parnham House, Pembury Road, Clapton, N.E.*, **not later than the 15th of the month.**

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The Astronomical Register.

No. 86. FEBRUARY. 1870.

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ROYAL ASTRONOMICAL SOCIETY.

Session 1869–70.

Third Meeting, January 14, 1870.

Warren de la Rue, Esq., F.R.S., *Vice-President*, in the chair.

Secretaries—Mr. W. Huggins and Mr. E. J. Stone.

The Minutes of the last meeting were read and confirmed.

Thirty-one presents were announced, and the thanks of the Society given to the respective donors.

William Garnett, Esq., J. N. Eustace, Esq., J. E. H. Peyton, Esq., Capt. J. Williams, and Lieut. H. Yeatman,

were balloted for, and duly elected Fellows of the Society.

Dr. Mann, Mr. Prideaux, and Mr. Penrose were duly appointed to audit the Treasurer's accounts.

The following papers were read:—

Seventh Catalogue of Double Stars observed at Slough in the years 1823–28 *inclusive, with the* 20-*foot reflector*, 84 *of which have not previously been described*: by Sir J. Herschel.

These observations of double stars were made in the course of the author's earlier sweeps, and would have been included in his third catalogue but for two reasons, one being that it was desired not to include in that list any but newly discovered double stars,

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and secondly, that the number was not to exceed an even thousand. Many of the present catalogue are to be found in Struve's, and they are now brought before the Society to be included in Sir J. Herschel's general synoptical catalogue. With respect to the magnitudes adopted the author gave a table for comparison with Struve's magnitudes, which, showing slight differences as to the brighter stars, departed widely from one another when faint bodies were reached.

The tabular matter was, of course, taken as read.

The Chairman: Sir J. Herschel worthily employs his leisure in summing up the series of observations begun by his father and continued by himself, and is laudably anxious that no single observation which may be of use to science should be lost. He deserves our warmest thanks for his kind contributions to the Society.

Observations of Jupiter's Satellites and Occultations of Stars: by Mr. Joynson.

Summary of Sun-spot Observations made by the Kew Photo-heliograph during the year 1869: by Messrs. De la Rue, Stewart, and Loëwy.

	Days of observations.	Days without spots.	No. of new groups.
January	14	0	15
February	15	0	17
March	11	0	14
April	20	0	15
May	16	0	18
June	18	0	27
July	22	0	18
August	19	0	25
September	21	0	21
October	18	0	17
November	11	0	15
December	11	0	22
	196		224

The Chairman stated that he wished to take the present opportunity of publicly thanking Miss Beckley, the daughter of the mechanician at Kew, to whose unwearied assiduity the taking of the pictures was due, and in order to procure which, without losing any possible opportunity, she had to exercise an amount of patience such as, he believed, could only be met with in a lady. The photographs, when obtained, were carefully measured by Mr. Loëwy, and then discussed by the firm of De la Rue, Stewart, and Loëwy. In two years more the decennial period of sun-spots would be complete, when they had great hopes of being able to do something to supplement the excellent work of Mr. Carrington.

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Observations of Meteors on November 13, 1869, *at the Coast Survey Station, Santa Barbara, California*: by Mr. Davidson.

A table and curve of the frequency of the meteors were given. The night was beautifully clear, but up to 1h. 20m. only 22 had been seen. From thence to 3h. 20m. a strict watch was kept, with the results tabulated. After that all grand display ceased. Some of the meteors were very brilliant, of which the details were noted. The train of one continued visible 8½ minutes.

Occultations of stars by the Moon at Maresfield, Sussex: by Capt. Noble.

The details of these observations were given, and the observer remarked that he had hitherto derived his latitude and longitude from the ordnance survey, and adopted 51° 0′ 58″·3 N., and 17 S. ·5 E. as his position. In order to test the value of the observations Mr. Penrose had kindly computed the longitude from one of the occultations, and found the determination from that single observation differed only 1,300 yards from the one he used.

On a bright cross Micrometer for measuring the position of lines in faint spectra: by Mr. Browning.

On attempting to map carefully the spectrum of Jupiter Mr. Browning had met with great difficulty in measuring the position of some lines at the red end, where it was not bright enough to show the usual micrometer wires. The lines in question had been figured by Mr. Huggins, and appeared to be not Fraunhofer lines, and therefore were probably due to Jupiter's atmosphere. They were thick, and more like absorption bands produced by liquids than ordinary solar lines. To obviate this difficulty he had contrived an apparatus adapted to his star spectroscope, which he explained by a diagram, and also exhibited to the meeting. It consisted of a mirror to throw light through a piece of smoked glass in the side of the spectroscope tube, upon which a cross had been scratched, and the image of which, by a prism, was thrown upon the spectrum, and could be moved by a micrometer. The cross had not been very clearly marked in this case, and tin foil had been tried with no good result, but he expected to obtain a photographed image, which would show very clearly. The luminous cross was strongly visible at either end of the spectrum, where the light grew faint.

Mr. Bidder said he thought the plan described was capable of application to ordinary telescope measurements, and that he had so suggested to Mr. Browning. He also described and drew a diagram of a plan he had adopted for double-star measures, which he had derived from Sir W. Herschel's description of his lamp micrometer. By means of a split lens Mr. Bidder obtained two images of a light on his telescope in the same field of view

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with stars, and as, by micrometer screws, these images could be superimposed, or otherwise moved in the field, the measurements could thus be obtained without illumination of the field and extinction of faint stars. The plan he thought likely to become very useful.

Mr. Browning said he considered Mr. Bidder's plan had in it the elements of the best position micrometer he ever saw, and that both distance and position might be obtained from it. He had not, however, been indebted to it for his contrivance, but had taken an idea from the continental spectroscopes, which, as Mr. Huggins knew, generally had a third tube containing an illuminated scale, an image of which was, by a prism, thrown on the spectrum. Mr. Huggins had told him that he would find this scale useless, and so it had turned out; but the method of placing it where it was required had led him to the system adopted.

Mr. Huggins wished to make one practical suggestion, namely, that a series of coloured diaphragms should be added, so that light of different colours could be used to illuminate the cross according to the part of the spectrum where it might be wanted.

Mr. Lockyer made another suggestion, that the light which supplied the cross should be moveable by the micrometer, so as to keep things in the same relative position. He had been much bothered by the continental plan of a scale. He did not know whether his notion was practicable, but it was certainly desirable.

Mr. Huggins further suggested that the colours required might be obtained by the action of a small prism on the light.

The Chairman offered the thanks of the Society to Mr. Browning for the perseverance with which he followed up the subject of spectrum analysis, and invented new appliances to render observations with the spectroscope easily available.

The Chairman said that, understanding the great refracting telescope, the construction of which had been undertaken by the late Mr. Cooke for Mr. Newall, was now complete, he would call on Mr. Lockyer, who had seen it, to give some particulars to the meeting.

Mr. Lockyer: When recently at York and afterwards at Gateshead, I had the opportunity of seeing this magnificent instrument and the observatory constructed for it, and I thought the Royal Astronomical Society would like to know something about it. I have been furnished, by the kindness of Mr. Newall, with the photographs of the telescope and building, which I now pass round. The object-glass of the telescope is 25 inches in diameter, and England may well be proud of it. This is 6½ inches larger than the Chicago telescope made by Alvan Clark,

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generally considered the largest in existence. The mounting may be said to be almost unique, being on the German form instead of, like the Greenwich and Cambridge equatorials, on the English plan. The photographs of the eye-end of the telescope and of the polar axis speak for themselves, and the man standing near supplies a scale for measurement. The observatory is 25 feet in height and diameter, and has been built from Mr. Newall's own design, who has also constructed a most ingenious observing-chair. Of the performance of the telescope I shall say nothing, except that, with a low power, I saw γ^2 Andromedæ decidedly double, and that I should be glad if I could always see Jupiter as I then saw him. I shall not commit myself to any opinion with regard to the higher powers, on account of the state of the atmosphere. One point mentioned to me by Mr. Newall is of the greatest importance to the advancement of science, namely, his intention, when the instrument is properly fixed in a good climate, to place it at the disposal, for a certain number of hours in each day, of any competent astronomer who will take the trouble to travel to it.

The Chairman said that Jupiter was now a remarkably fine sight, and he would ask Mr. Lockyer to state presently how the satellites looked, as they afforded good tests of definition. He might also mention that the so-called German form of mounting was really English in its origin, and was due to Hooke, the inventor of the universal joint known by his name, and the contemporary of Newton. The plan would be found described and figured in his *Tracts*. The completion of Cooke's telescope would, he believed, form quite an era in astronomical science. There was, however, he understood, a very fine instrument of 22 inches aperture in the possession of Mr. Buckingham, who too rarely favoured the Society with his presence or communications.

Mr. Buckingham said he had been observing Jupiter before coming to the meeting with the telescope referred to, which was 21¼ inches in aperture, and he found the reddish equatorial belt resolved itself into markings apparently like marbles, with a whitish basis between them, suggesting the idea of clouds, and a photosphere visible below them. He had also noticed a new belt since yesterday, and mentioned some observations with the spectroscope which showed some important lines at the red end of the spectrum.

The Chairman stated that he could confirm the account given by Mr. Buckingham of the markings on Jupiter, having seen them himself two nights ago. He thought very few were aware of the existence in London of such a fine instrument, and he could not help accusing Mr. Buckingham of "hiding his light

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under a bushel." The Society would be glad if Mr. Buckingham would communicate his observations regularly, which must, in the end, be of great advantage to science.

The Chairman further said the papers were exhausted, but they had still the *bonne-bouche* of the evening in reserve, being the exhibition and description of a new transit for the Indian Survey, by Col. Strange.

Colonel Strange then uncovered and exhibited the instrument, being *a portable side-view Transit*, made for the Indian Survey by Mr. Cooke. He said: This is a piece of admirable workmanship, and as it is a form of instrument not much known, I thought the Society would like to see it. It is usually called the *Russian Transit*, from the fact that when the officers of the Russian Survey were in England some years ago, they used such an instrument at Greenwich, where it was seen and much admired by many persons. Among them was Col. Walker, who applied to the Indian Government for two such Transits. The request was complied with, and they were ordered through me. The late Mr. Cooke examined the Russian form with great care, and made the instrument before you. Its peculiarity is that the telescope is, so to speak, bent at right angles, a prism being inserted at the angle, throwing the cone of rays along the axis, one end of which becomes the eye-piece. The position of the observer, therefore, always continues the same, whatever the altitude of the star, and the height is diminished, constituting a very great convenience. Still, when this form of instrument was proposed for the Indian Survey, I rather dissented, and am not yet quite convinced that it will be an advantage. In speaking of my objections, I pass over the manifest ones of loss of light by reflection and the impaired performance of the object-glass, and come to the question of permanence in the adjustments. An ordinary Transit is subject to two sources of disturbance, apart from flexure of the tube and axis. Error may arise from disturbance of the object-glass by the jar of a blow or concussion in travelling, or the plate carrying the wires may suffer in the same way. In a common Transit these parts are separated by the whole length of the tube, and therefore any linear disturbance produces the least possible angular displacement. Here it is not so. The prism is a small body subject to the same disturbance, and the effect is greater as the distance from the object-glass is smaller. In this instance the prism is 2 inches across and only 34 inches from the object-glass. The effect is, therefore, seventeen times greater than between the objective and eye-piece. The answer to this is, that such disturbance of the prism does not take place. Captain Clarke, of the Ordnance Survey, has tried a similar instrument, and reports that after much travelling the collimation is not

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deranged. I like to have a principle on my side. The prism may be well fixed, but still it is likely to move by jerks not equally applied; and although the change may be detected, it might happen where there is an absence of mechanical aid, and much delay might be occasioned thereby. I am therefore rather against the use of these instruments on the Indian Survey, where we are often a long way from workshops, but they have been desired to test and experiment upon. One great point is the ease of reversal, which is accomplished rather differently in this to the Russian one. By means of handles acting upon a cam the whole axis is lifted and reversed easily, without any sensible disturbance of the attached level, which is suspended from the axis. The level can of course be taken off and reversed separately. The whole arrangement looks novel, and its efficiency has yet to be ascertained. The lamp is fastened to one of the pivots, and goes round with it. There are a series of diaphragms and coloured glasses for modifying the light.

One peculiarity detected by Capt. Clarke was a change in the collimation at different altitudes. If the prism be disturbed in different directions, the collimation is affected in the opposite ways. The telescope is subject to flexure: when upright, it disturbs the prism horizontally. When the telescope is horizontal, the flexure disturbs the prism vertically. Capt. Clarke perceived this, and tested the amount of error produced by using an inclined collimator. His paper contains formulæ for correcting the error resulting; and this is a most important contribution, as, without the means of obtaining such correction, the instrument would not accomplish what is expected of it.

Mr. Carrington: Why not suppress the telescope altogether? Place the object-glass at the end of the axis, with a prism outside it, as in my instrument.

Col. Strange: I am not sure we could get a prism large enough, or that it would not interfere with the performance of the object-glass. I very much prefer not tampering with the cone of rays between the objective and eye-piece.

Mr. Carrington: My prism is 6 inches across. It was made by Chance, after several failures, and cost me 60*l.*

Mr. Stone: Is there any change of level from the heat of the observer's body, who stands at one end of it?

Col. Strange: I have not yet tested the instrument as to this point. Capt. Clarke refers to it and also to the heat of the body affecting one support, and suggests that he should stand near it as little as possible.

The Chairman: Or interpose a screen.

Col. Strange: In observations where there is a great difference of temperature between the air and the human body, such as an

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Arctic climate, I should say this is the wrong instrument altogether; but in India the temperature is generally about the same as that of the body, though the nights are occasionally very cold.

Mr. Simms: Capt. Clarke interposed a plate of brass to cut off the observer from the level.

Mr. Stone: When Col. Forss was at Greenwich he admitted such an effect could be produced, and, to avoid it, jocularly recommended that a person of about the same size should stand at the other end.

Col. Strange: I omitted to refer to the levelling screw, which is copied from the plan devised for the great theodolite, which I hope will shortly be ready for India. The Transit of course requires two adjustments, one to place it in the meridian, and the other to level the axis. When screws are loose enough to allow of these they generally shake, and must be clamped, but the act of clamping after the adjustment produces strain and disturbs the level. I wished to avoid this, and therefore the levelling screw acts, not upon the base of the instrument but upon an intermediate plate, attached only at the centre and therefore elastic, but the ends are so secured that if it were attempted to move the instrument in azimuth this cannot be done by any ordinary force, consequently the axis is raised and lowered without risk.

Mr. Simms: We had great difficulty in making an instrument like the Russian one, particularly in getting a good prism, but it was done at last. A defect was then found arising from clipping the prism too tightly, but after this had been eased it worked well.

The Chairman: Supposing a sufficiently large prism can be obtained, which would Mr. Simms prefer—this form or Mr. Carrington's?

Mr. Simms: I should feel no difficulty now as to holding the prism.

Mr. De la Rue, having resigned the chair to Capt. Noble, said that although Mr. Carrington, adopting Steinheil's plan, suppressed the telescope tube altogether, many persons objected to the exposure of the prism; and he therefore suggested, and drew a diagram of, a method of obviating this by placing the object-glass in a cell at the side of and near the pivot of the axis, with the prism immediately below it.

Capt. Noble said that in the first vol. of "Smyth's Celestial Cycle" was an engraving of an instrument very like the Indian Survey one, but having the tube near the illuminated end of the axis and counterpoised, while the reflection at right angles was done by a plane mirror instead of a prism. He believed this was called the Englefield Side-Transit, and was referred to in a way showing it was pretty generally known then.

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Mr. Browning: I think the Russian would be the better position with regard to the performance of the object-glass.

Mr. Huggins thought the Englefield Transit was specially devised for use at a window having an east or west aspect, and therefore requiring to look at right angles.

Capt. Noble (chairman): Possessing, as Col. Strange does, an intimate acquaintance with the theory of instruments and mechanical skill of the highest order, his communication is of the greatest interest, and as such is fully appreciated by the Society, which offers him its warmest thanks.

Mr. Stone, at the request of the Chairman, gave an oral account of his *Experiments on the Heat of the Stars*, being the substance of a paper he had communicated to the Royal Society. The apparatus was devised and used last year, but he then got merely indications of sensible heat, without having any means of ascertaining its amount. He felt this was essential, in order to get the apparatus into practical working order. He would explain roughly the present arrangements, which consisted of a thermo-electric pile, or rather two in one case, the wires connecting which passed through a galvanometer. The piles, being placed in the telescope tube, were affected equally by any extraneous influences, and the galvanometer suffered little or no change, furnishing him with a steady zero. The star was then focussed on one face of the pile, and the effect noted. It was next moved to the other pile, when a deflection in the opposite direction occurred; and large numbers of these observations were made with each star, giving results of very considerable reliability. Still, this only proved the heat received was sensible, and very small in amount; but what was that amount? To get at this he dismounted the piles, and placed them on a stand before a Leslie's cube of boiling water. An intercepting glass plate was then employed to cut off the heat from each pile alternately; and by the use of thermometers in front of the piles, and the deviations of the needle, a direct comparison of the effects was procured. Then, by ascertaining the absorbing power of the glass and the effect of varying the distance of the cube from the apparatus, and the employment of many other precautions and much calculation, a definite result for the heat of the stars was arrived at in degrees of Fahrenheit's thermometer. The chief results are, that in the case of Arcturus the heat received by the telescope of $12\frac{3}{4}$-inches aperture amounts to two-hundredths of a degree, while the heat from α Lyræ is nothing like so much, in fact only about half that quantity. The direct heat received by the earth from the stars is therefore excessively small. It may be remarked that Arcturus is a red star and Vega a bluish one, and that in a spectrum the red end is the hottest and the blue the coolest part. A connection is there-

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fore traceable here between the existence of an atmosphere cutting off the red rays in one case and not in the other. When the air was saturated with moisture, however fine it might be, no effects could be obtained; and if, while the needle was deflected, the *slightest* cloud was formed, the needle returned to zero. Professor Tyndall had observed analogous effects in some experiments of his. There was another way of representing the heat received from Arcturus, viz. by stating it as equal to that falling on a body from a cube of hot water 3-in. square, placed at a distance of 400 yards.

Mr. Lockyer enquired whether Mr. Stone had varied the focus?

Mr. Stone replied in the affirmative.

Capt. Noble said that the relation of such researches and results could not but inspire us with wonder and admiration: wonder, that the light emanating from such enormously distant bodies—the remoteness of which was all but immeasurable—should still carry with it the associated heat which was capable of detection, although subject to being cut off by the merest film of vapour; and our admiration would be no less than our wonder, when we considered the ingenuity, perseverance, and talent of the most consummate kind displayed in such investigations as those just described. In the name of the Society, Mr. Stone must receive its heartiest thanks.

The meeting then adjourned.

PROFESSOR DONATI'S LECTURE ON SOLAR PHENOMENA.

Concluded from p. 20.

With the sun, and therefore with its phenomena, is found, perhaps, likewise connected the phenomena of the *zodiacal light*, which, at the beginning of spring and the end of autumn, is seen for some time in the west, after the evening twilight, or in the east before the dawn, and which terminates in a point like a pyramid. To explain this appearance many hypotheses have been made, which, however, almost all agree in assigning it to an immense mass of very small and thin bodies spread in a certain zone round the sun, whose light they reflect, or emit their own. That an enormous quantity of such little bodies are scattered in space is unquestionably proved by our *aërolites* or *falling stars*, which are only very minute fragments of cosmical matter, which enter our atmosphere, and, igniting, are consumed. He who wishes to be thoroughly acquainted with their origin and laws should consult the recent labours of Professor Schiaparelli, who has succeeded in resting on the falling stars a firm and enduring foundation for his own name.* For our present purpose it is enough to know that an infinite number of very small bodies are wandering in space, of which most probably an immense mass gathers itself round the sun by reason of its great attractive force. This being admitted, as it assuredly must be, M. Mayer, a physician of Heilbronn, Mr. Waterston, Professor Thomson, and other learned men, have supposed that some of those corpuscules that

* Memoirs of the Italian Society of the XL., series iii. vol. i. part 1. Florence, 1867.

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are agglomerated round the sun, and produce the effect of the zodiacal light, fall with so great a velocity on the sun itself that they constantly produce by their collision a development of heat sufficient to supply that which the sun loses by radiation. It results from the passages from Galileo and Newton I have before referred to, that these two great philosophers also believed that the sun might, nay must, receive from without some restoration for the loss of heat and light which it continually sustains, and also recent scientific discoveries confirm this opinion. The *meteoric origin* of the solar heat appears, then, very worthy of acceptance; since those very small fragments of cosmical matter which the sun gathers to itself from the immensity of space, falling upon it with excessive velocity, may very well (without sensibly augmenting its volume) develop, by their impact, a great amount of heat; and the causes we have already referred to, in conjunction with this conservative cause, may constantly produce those phenomena which have amongst themselves the relations already mentioned.*

But the phenomena of the sun and the planets are not merely linked together, and with other visible phenomena, but they depend, moreover, on something that is invisible to us, and yet which has a material existence. The sun moves in space with a velocity about four times greater than that of our globe in its orbit, and the earth and all the other planets follow it in this movement, almost as chickens go after the hen. Such a fact, about which it is now impossible to doubt, proves that just as the planets are attracted by the sun, and the satellites by the planets, so the sun is attracted by one or more bodies concerning which we do not even know what or where they are, and which will perhaps always remain to us unknown and invisible. May not this body or these bodies, which draw in infinite space the entire solar system, modify the phenomena of our system, and be, for example, the primary cause of those changes of terrestrial magnetism which, as already observed, are developed in the course of ages? Certainly we are here in the region of the invisible, but still not in that of fancy; since the knowledge of the universe does not depend only on the power of the eye even armed with the best telescopes, but the human intellect attains also to the knowledge of many things which the human eye does not see.

To sum up: it follows from what has been said, that certain phenomena which happen in the sun and planets have a reciprocal relationship and almost common origin; that the cosmical matter found disseminated in the infinity of space, and which wanders from one to another of the vast stars that occupy the universe, very probably furnishes our sun with the force with which it gives life to all the planets; and, finally, that these follow it in the path in which it is constrained to move in space in virtue of a force situated in far distant regions.

The planets, then, and our own globe, share in the life of the sun and of the most distant stars, and receive from them a species of *influx*. But an *influx* of what a different sort to that which astrologers once imposed on the credulity of an ignorant and superstitious multitude! Astrologers indeed, were not disinterested and open cultivators of true science, but rather covetous and secret traffickers in a false knowledge. He who has truly in view the acquisition of truth, however he may sometimes involuntarily err, ever seeks to make known to others the facts and reasons which guide himself.

Nè fa manto del vero alla menzogna. †

* On the *meteoric theory* of the Sun and its history, see Lecture xii. of Tyndall's work *On Heat.*

† Nor covers falsehood with the mantle of truth.

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CORRESPONDENCE.

N.B.—We do not hold ourselves answerable for any opinions expressed by our correspondents.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

ASTRONOMICAL LIBRARY.

(See last number of the REGISTER.)

Sir,—How four or five pounds may best be invested for one, must depend upon the mathematical attainments of the purchaser. "Advanced treatises," theoretical and practical, not only demand advanced mathematics, but would probably require the whole sum, leaving nothing for elementary works. But as to *these*, I should say, let the student procure *Descriptive Astronomy*, by George Chambers (Clarendon Press), and Sir John Herschel's *Outlines of Astronomy*. In the former (pp. 704–706) he will find a list of works necessary or desirable for the amateur. I wish the purposed new edition of "Smyth's Celestial Cycle" could be set down in the next place; but we must still wait and long for its appearance; and the best thing of the kind next to it is "Webb's Celestial Objects for Common Telescopes." After this, by the time our friend has furnished himself with star and lunar maps (Mr. Proctor's contemplated new Atlas would probably be the best for the stars), above half of his assigned capital will have been expended; and the most judicious mode of laying out the residue must depend upon the particular branch of the science he intends to cultivate. In general, as many books as can be got would be desirable; since what is omitted, or, perhaps, obscurely given in one, is often supplied or more satisfactorily expounded in another. Expense may often be saved by waiting a little, and looking out for second-hand copies. Amongst general elementary treatises there are *Loomis's Treatise on Astronomy; Lockyer's Elementary Lessons in Astronomy; Lectures on Astronomy, by the Astronomer-Royal; Lardner's Hand-book* (I refer to the original edition); *Practical Astronomy, by Hugh Breen; Denison's Astronomy without Mathematics; Hind's Introduction to Astronomy; Rudimentary Astronomy, by Rev. Robert Main; Mitchel's Popular Astronomy; Drew's Manual of Astronomy*; and others, most of which are inexpensive, and all desirable acquisitions.

And the happy possessor of the 8½-inch reflector I hope is, or intends to be, a subscriber to the *Astronomical Register*, and perhaps a member of the Observing Astronomical Society. Apropos of astronomical libraries, it has occurred to me whether it might be possible for the *Register* to become a medium for the *exchange* of books and instruments, as, in regard to a much greater variety of articles, is such a paper as the *Queen*, for instance. This might increase the utility of a periodical which has revealed an amount of interest in our noble science probably without a parallel at any former time. It seems as if at no previous period were the heavens scoured by so great a number of fine refractors and reflectors. In some cases they may not be much more than the means of a refined enjoyment to their possessors; yet even this deserves commendation. It is at least a recreation more elevating and intellectual than hunting foxes or racing horses; and the fascination of a telescope may be the accidental means of giving the first impulse to some future distinguished disciple of Newton or Galileo. The number and the interest of the contributions of all kinds in

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past years to the *Astronomical Register* may well make us very hopeful about the time to come. Let us all, editor and correspondents, take fresh heart and courage, and, realising a kind of fraternity, prove able not only to appreciate the achievements of our far-reaching masters in science, but to sympathise with the difficulties and aspirations of its humblest votaries, and, as far as possible, lend them a helping hand.

I am, Sir, yours, &c.,

Teignmouth: Jan. 1870. GEORGE J. WALKER.

THE SHADOWS OF JUPITER'S SATELLITES.

Sir,—This has been a subject of interest to me for some time, and I was therefore pleased to see "Viator's" communication on page 14, with your own interesting addition.

I may be permitted to mention here that the observations of the shadows of III. and I., noticed on page 49 of the last volume of the *Register*, had been made before I had seen Mr. Proctor's article in the *Student*.

A determination to see a good many transits during the present apparition of Jupiter has only resulted in disappointment (chiefly through unfavourable weather), except in a solitary instance.

1869, Nov. 15, with a clear sky, and tolerably steady air, the transits of III. and its shadow were observed with my 9-inch "With-Browning" reflector. The satellite went on very near to the planet's S. limb, and at mid-transit the clear space between it and the limb was only about half the diameter of the satellite. III. was then bright and very conspicuous, and readily visible with 3-in. clear ap. and power 132. About this time the shadow entered upon the disc of Jupiter, a little N. of the path of III. With power 212 the true umbra was clearly seen, surrounded with a brownish annulus, and watched until its egress was near. While III. was on the disc the intensely black umbra was found to be about two-thirds of its diameter, and the breadth of the annulus about equal to one-third of the diameter of the umbra, so that about two-thirds of the theoretical penumbral band was seen. Other powers—132 and 320—also showed the compound character of the spot, but 212 the most plainly.

There is reason for believing that the recorded appearances of both moons and shadows in transit are not so anomalous as sometimes supposed, if two very important elements in every observation were noted. It is extremely improbable that any telescope could show *all* the penumbræ of any satellite, especially of the third and fourth, and we have a striking proof of the effect of contrast in some transits of satellites; it is therefore necessary that the distance of the object from E. or W., N. or S. limb, and its path—referred, if possible, to a belt—noted.

Could those observers who have seen penumbræ furnish these elements, with particulars of sizes and breadths? I think it likely that at the time of Mr. Lassell's observation in 1850 the shadow did not go far from the limb: it is very probable that penumbræ would be more obvious there than in the centre of the disc.

On the evening of Nov. 15 there were visible on the broad yellow equatorial band six or seven white spots with grey outlines attaching them to the S. dark streak adjoining, and arranged at nearly equal distances in a line extending across the planet.

I am, Sir, yours truly,

Earith, Hunts: Jan. 13, 1870. T. H. BUFFHAM.

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THE NOVEMBER METEORS.

The following letter from Commander Gibson, of the U.S. Navy, which appears in the *Boston Sunday Courier* of January 2, will be read with interest:—

"*The November Meteoric Shower.*

"Navy Yard, Pensacola, Nov. 15, 1869.

"Sir,—The meteoric display of the night of the 13th-14th inst. was seen here under favourable circumstances, and in great brilliancy, and I send you a brief description of it, for the sake of calling attention to one or two of its features.

"The night was still and cloudless; and after the moon was down, the beauty and transparency of the sky, with its broad belt of equatorial constellations culminating in Orion, with Sirius and the planet Jupiter, Capella, and Canopus confronting each other in opposite quarters, or 'rival houses of the heavens,' and with a clearly-defined pyramid of zodiacal light, shining wonderfully bright and reaching high towards the zenith, were something remarkable, independent of the showers of the shooting stars. These were observed in extraordinary numbers from 1.15 A.M. until lost in the dawn, swarming most between the hours of 3 and 4. It is difficult to give an average of the number per minute. It varied from two or three to twenty or thirty, or more, and it was never uniform for equal spaces of time, the star showers flashing and intermitting like the bursts and pauses of the gusty rain.

"Their paths were dispersed pretty freely over the whole heavens, but the principal point of divergence was in the constellation Leo. Few or none were observed to radiate from Perseus. We saw every variety of these 'meteoric asteroids,' from fine spidery threads and mere moving points of light, to great meteors, which exceeded the apparent diameter of Jupiter, and burst in splendours of orange and crimson fire. Two of the larger class, after apparent combustion, remained for fifteen minutes visible as small nebulous or cometary stars of the second or third magnitude, with distinct nuclei in misty rings. One of these was near the outer of the index stars or pointers in Ursa Major, and one far to the southward, near or in Argo. But the most remarkable exhibition of all was that of a large 'fire ball,' which fell rather slowly from near Aldebaran, and burst in Aries. For many minutes a portion of its tail (about five degrees in length) remained printed on the sky, forked in form like the conventional representation of a thunderbolt—the lightning fixed where it had finished. This apparition finally changed, and spread horizontally into a small white cloud or vapour wreath (about four degrees by two) of nebulous phosphorescent lustre, which drifted slowly to the northward, and remained visible and luminous for at least fifty minutes. Its apparent substance differed in no respect from that of the tail of a comet.

"Very respectfully your obedient servant,

"WM. GIBSON,

"*Commander U.S. Navy.*"

ECLIPSE OF THE SUN, DECEMBER 1870.

Sir,—Which will be the best station for observing the total eclipse of the sun on the 22nd of December next, taking into consideration the probabilities of fine weather, the sun's altitude, and the duration of totality?

From the data given in the *Nautical Almanack* it appears that the line

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of totality enters Europe about 40 miles north of Cape St. Vincent, passes 19 miles north of Cadiz, and quits Europe about 30 miles north of Gibraltar.

It then crosses the Mediterranean and enters Africa close to Oran, passes 94 miles south of the city of Algiers, and quits Africa 45 miles south of the city of Tunis. It next traverses a corner of the island of Sicily, passing midway between Catania and Syracusa, and about 16 miles from either.

I know, from personal experience, that the winter weather in the south of Italy is often very unsettled, and is not to be depended upon; and I doubt if the south of Spain is much better, owing to the proximity of the Atlantic.

But how about Algeria? Oran is on the African continent, is lower in latitude than either Spain or Sicily, is very near the line of totality, and can be reached in 5 days from London, *viâ* Marseilles. The sun is also near the meridian during the totality there. What are the probabilities of good weather at Oran? Would some of your readers kindly state their opinions on the matter, and oblige

Gosford Green, Coventry: Yours truly,
Jan. 14, 1870. WILLIAM ANDREWS.

THE ALTAR AT STONEHENGE.

Sir,—In the original plan of the seven trilithons and altar at Stonehenge, forming the illustration of my second article, "The Astronomy of, and Druidical Worship at Stonehenge," I see the engraver has given a raised altar, owing, perhaps, to some indistinctness in the draft I had made. All who visit Stonehenge would notice that the altar of that ancient temple is a *flat*, and not a raised one.

Though the error is not material as affecting the illustration, still, I shall feel obliged by your giving the insertion of this notice in the next number of your *Astronomical Register*.

I am, Sir, yours faithfully,
J. H. BROOME,
Rougham: Jan. 7, 1870. *Vicar of Houghton.*

THE "ATHENÆUM" AND THE ASTRONOMICAL SOCIETY.

Sir,—Can you or any of your readers inform me why no notice is taken in the *Athenæum* of the Royal Astronomical Society's meetings? The *Athenæum*, to a certain extent, holds the same place in literary and scientific matters as the *Times* does in the general occurrences of life; and it seems scarcely fair that the proceedings of one of the first of the learned societies should be systematically ignored in its columns. It is very rarely that any account of its proceedings is given, and then, as far as I recollect, only the heads of the papers, while in the list of "Meetings for the ensuing week" the Royal Astronomical Society is usually omitted, even embryo institutions, such as the Victoria Institute, being allowed to appear. To assure myself that there is truth in this, I have looked over the index of the *Athenæum* for the last six months, under the head of *Societies*; and while the Asiatic Society of Bengal, and the Yorkshire Geological Society, are inserted, the Royal Astronomical Society of London is not deemed worthy of a place. Surely a Society devoted to the study of the most elevated of the sciences deserves more attention than this from a journal professing to

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represent the literary and scientific progress of the age; its readers might imagine that the Astronomical Society was defunct—whereas the fact is, that the meetings, which some years ago mustered but a spare sprinkling of Fellows, are now so crowded that sitting accommodation can hardly be obtained, and the constantly increasing number of members on the list is a proof that the science as well as the Society is strengthening its hold upon public favour.

I am, Sir, yours obediently,

London: Jan. 16, 1870. AN F.R.A.S.

OBSERVATIONS MADE AT THE OBSERVATORY OF MR. E. CROSSLEY, PARK ROAD, HALIFAX.

BY JOSEPH GLEDHILL, F.G.S., &c.

Plato.

Spots and Streaks.—On the 15th, after a cloudy, damp, sunless day, the sky suddenly cleared about 11h. The air was still, definition fine, and the motion on the moon's edge exceedingly small. At 12h., the door, window, and dome having been open some time, the 9½-inch equatorial was turned upon Plato. In five minutes no less than twenty-one spots or craterlets were seen. These were 1, 17, 4, 3, 30, 8, 7, 6, 5, 2, 0, 18, 23, 14, 12, 22, 16, 9, 11, and two others not yet fully aligned. Besides these spots and craterlets, the well-known streaks were finely seen. Of these, fourteen different streaks or bands were readily counted. Soon after 13h. the moon became surrounded by a dense yellow haze, which put an end to delicate observation. Before 11½h. twenty spots had been seen by Mr. Edward Crossley, F.R.A.S. During the preceding seven lunations, perhaps only one night was equal to the 15th of January 1870.

The Aurora of January 3.

After a dull, sunless, calm day, the sky cleared at 5 P.M., with vane at south-west and rising barometer. From 5 to 6 o'clock the sky was mostly clear, but from 6.30 to 7 it was a good deal overcast, rendering transit observations impossible. At 6.50, while observing Jupiter, the sky became suddenly clouded, and I went away to the Anemometer-room to look at the trace. On returning to the observatory, about 7.10, and pointing the equatorial to Jupiter, I saw a broad, bright band of light lying across the opening in the dome. There was an aurora. The description of the phenomenon may conveniently be given under the heads: 1. The bright band; 2. The arch. As the former lay across the sky from east to west, and below the zenith towards the south, and the latter lit up the northern sky, it was not easy for one observer to watch both with great precision and in detail.

1. *The Bright Band.*—This fine object lay nearly east and west, and extended nearly from horizon to horizon. Its east end did not extend beyond the Twins. Its path lay through δ Geminorum, ι Aurigæ, ζ Persei, just to north of α Andromedæ, through α Pegasi, through Aquarius down to the west horizon. It was a dense, luminous, white beam, through which the smaller stars could not well be seen. Its breadth was about 5°. No trembling motion, nor yet any change in density or colour, was observed. In the west part of Auriga a slight bifurcation commenced, and the two forks were very straight, and sharply defined. At 7.20 the whole beam had fallen towards the south horizon, and lay through the Pleiades, α β γ

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Arietis, α Andromedæ, and on to the west horizon. At its east end it now passed between ι Aurigæ and β Tauri. About this time the south and south-west sky became overcast, and the bright beam was for some time invisible in Pegasus, but was very bright thence to the west horizon. At 7.27 the clouded sky hid the bright belt from view. At 8.10 it was again seen as a much broader and less luminous band, some 15° in diameter, and lying from β Aurigæ through the belt of Orion, to the Pleiades, and again its east end was bifurcated. When the sky cleared at 8h. 30m. no trace could be seen.

2. *The Auroral Arch.*—On turning to the north at 7 P.M. a dark, very flat arc lay on the horizon, very like a cloud. This measured only about 3° or 4° in altitude. Above this, and extending from north-west to north-east, the sky was lit up by a whitish luminous haze, through which all the larger stars could be well seen; the tail of the Bear, Aquila, Lyra, and the lower portion of Cygnus were noticed through it during the evening. The altitude of the highest point of this bright segment was about 15°. The tints varied; sometimes the colour was bright white, then it was blue, and then of a bluish green. Passing clouds often gave a strikingly wild effect to the celestial scenery. The upper edge of the segment was bounded by an arc of the most lovely rose, some 20° in diameter. This was the most magnificent part of the phenomenon. While the bright palpitating lights shot up from the horizon to 50° of altitude, the rosy corona expanded and covered the sky up to near the zenith. Again the fiery vault became dim, and dark masses of anvil-shaped clouds passed in long procession across the scene. Now the clouds pass off, and the shining columns shoot with the rapidity of lightning from horizon to near zenith, while their lofty summits seem bent like drapery shaken by the wind. The columns which darted so fitfully were always vertical to the horizon at their bases; they were always a luminous white, and did not change colour when they crossed the glowing arc of the corona. They were best developed at the west-end of the great arch about ζ Cygni. At this point, when dark masses of cloud crept along from the south-west, the sky seemed to glow like a furnace, while brilliant beams shot out of the fiery spot, and then suddenly vanished.

At 7.27 dark clouds again passed from the south.

At 7.30 thin bands of stratus cloud lay under the rosy arch.

At 7.33 the ruddy glow lit up the small clouds in the zenith.

At 7.35 again huge triangular masses of cloud passed across the scene, and the south and west parts of the sky were overcast.

At 7.37 the corona was again well seen, and a few rays darted upwards from the west extremity of the arc.

From this time until 8.30 the south, south-west, and west portions of the sky were obscured by thin cloud, but a bright, soft light lay upon the clear northern sky.

At 8.5 the illumination extended to the south-west. A few bright rays were seen in the north-east at 9.30, and the sky was generally clear.

January 4th, 11h. 15m.—A clap of thunder heard, full sunshine, a little rain falling, and detached white clouds passing rapidly at a low elevation from south-west; wind fresh.

THE LIFE AND LETTERS OF FARADAY, by Dr. Bence Jones, Secretary of the Royal Institution, has just been published by Messrs. Longman & Co.—Subscriptions to the Faraday Memorial continue to be received by Mr. Hughes, at the office of the Royal Institution.

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BRIEF CORRESPONDENCE.

LARGE OBJECT GLASSES.—We still hear nothing of the performances of the great object glass, or rather, I should say, of the great telescope, constructed by the late Mr. Cooke, the aperture of which, if I recollect rightly, was about 25 inches. Can anyone enlighten us on this matter, which is really a national one? I might also ask, what became of that immense telescope which was erected some years ago on Wandsworth Common, about which so much was said, and from which such great results were expected? It would be very interesting could we obtain a detailed account of the performances of these large glasses, so many of which are now in existence; it would be invaluable as a guide to those who are about to invest money and labour in grinding large lenses. EXPECTANS.

[For some account of the great 25-inch telescope, our correspondent is referred to our Report of the Astronomical Society's Meeting in the present number.—ED.]

THE ECLIPTIC.—I have heard it stated that the Sun is longer in the Northern than in the Southern Signs in the Ecliptic. Is this so? and if so, what is the reason for it? Pray pardon my ignorance in this matter, and give a word in explanation to A TYRO.

COLOURED STARS.—Can you inform me where I can find a complete list of coloured stars? P.

NEPTUNE.—What size of object glass and what power are necessary to raise a disc with the planet Neptune, sufficient to make it immediately distinguishable from an ordinary star? LANCE.

LESCARBAULT'S PLANET.—We do not know that anything approaching to a verification of the existence of this planet has yet occurred; certainly it is not from want of watchful observation of the sun.

THE CENTURY QUESTION.—Are we now in the 70th or the 71st year of the present century? As in the year 1870 we are stated to be in the nineteenth century, ought we not equally to be said to be in the 71st year of the century? H. O.

[Next to the question of the *Moon's Rotation*, perhaps no subject of the kind has been the cause of more dispute than that of the date of the termination of one century and the commencement of the next. We therefore, before admitting to our pages any letters on this subject, think it better to quote the opinion of a great authority on the point, and give the following from Arago's "Popular Astronomy," vol. ii. p. 773:—"A difficulty is frequently raised among the reading public with respect to the question whether the 28th of March 1800, for example, should be included in the 18th or in the 19th century. The question, when well examined, amounts to this: Does the year which figures in a date refer to the current year, or to the year which has passed? When we write the 28th of March 1800, must it be understood that we have arrived at the 28th of March of the year 1800, which has not yet revolved, or that from the beginning of the Christian era there have already elapsed 1,800 entire years, increased by the month of January, the month of February, and 28 days of the month of March of the year 1801? To solve this question, we must examine how time was counted at the beginning of the Christian era, that is to say in the year wherein the birth of Christ is supposed to

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have occurred. Now, it is agreed that this year was counted as 1 from its commencement; so that the 28th of March, 1, was understood to refer to the 28th of March of the year 1, which had just commenced, and not to a complete year + the months of January and February and 28 days of the month of March of the year 2. It hence plainly follows that the whole day of the 31st December 1800 belonged to the 18th century, and that the 19th commenced only on the 1st of January 1801. This last date must in effect be thus translated: The first day of the year 1801, and not 1801 + a day of the year 1802."—ED.]

THE GREAT TELESCOPE AND THE OBSERVATORY AT MELBOURNE.—In addition to our notice of this instrument at page 17 in our last number, we may add that it is placed in a large building, recently erected, adjacent to the Melbourne Observatory. Of this Observatory and its origin and progress, we have gathered some interesting particulars from the volume of "Astronomical Observations at the Williamstown Observatory in 1861–1863," recently presented to us by the Government in Victoria. In this book Mr. Ellery describes the first steps taken for setting up an observatory, by the erection of a time-ball, about five miles from Melbourne, at a place called Williamstown, the object being to furnish correct time to the numerous vessels drawn to the place by the great gold discoveries. A small observatory was next established, the instruments for which were obtained from England; a regular Board of Visitors was appointed, and the whole worked well for several years. At length, as in the case of the Paris Observatory, civilisation, in the shape of bricks and mortar, encroached upon and surrounded the building; and it was thus, to a certain extent, rendered incapable of yielding results as exact as were desirable. A new spot, therefore, was chosen to the south of Melbourne, removed sufficiently from all sources of disturbance; and here, assisted by funds supplied by the Government, the present Melbourne Observatory was erected. Its position is lat. S. 37° 40′ 53″; long. E. 9h. 39m. 54·8s.

OCCULTATIONS

Observed at Teignmouth by Mr. G. F. Walker, 1869.

			h. m. s.
March 22.	*g* Geminorum, disappearance	... ...	9 7 32·9
June 18.	80 Virginis „ ...	... ...	10 36 34·3
October 16.	ψ^1 Aquarii „ ...	... ...	12 23 40·3

Times probably reliable to one or two seconds.

ECLIPSES OF JUPITER'S SATELLITES. 1869.

COMPARED WITH THE NAUTICAL ALMANAC.

			h. m. s.	
October 5.	I. Satell. imm.	...	12 44 59·6	Not very good observation.
	N.A.	...	45 6·7	
October 28.	I. Satell. imm.	...	12 57 6·9	Satell. very near the planet.
	N.A.	...	57 22·3	
„ „	III. Satell. imm.	...	12 49 54·9	Very gradual disapp.
	N.A.	...	47 49·4	
December 1.	I. Satell. am.	...	6 12 11·3	Uncertain to about 5s.
	N.A.	...	6 11 54·0	

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ASTRONOMICAL OCCURRENCES FOR FEB. 1870.

DATE		Principal Occurrences		Jupiter's Satellites		Meridian Passage
		h. m.			h. m. s.	h. m. Jupiter
Tues	1		Sidereal Time at Mean Noon, 20 45 57·7	1st Ec. R.	5 5 44	5 53·5
Wed	2	8 56 15 6	Conjunction of Moon and Venus, 9° 28′ N. Inferior conjunction of Mercury	3rd Sh. I. „ Sh. E.	7 10 9 14	5 20·0
Thur	3		Meridian passage of the Sun, 14m. 6s. after Mean Noon			5 46·4
Fri	4					5 42·8
Sat	5			1st Tr. I. 2nd Oc. D.	11 45 12 54	5 39·3
Sun	6			1st Oc. D. „ Ec. R.	9 2 12 32 41	Moon 4 34·4
Mon	7	11 51 13 43	Occultation, disappearance of μ Ceti (4) Conjunction of Moon and Jupiter, 4° 24′ N.	1st Tr. I. „ Sh. I. 2nd Tr. I. 1st Tr. E. „ Sh. E. 2nd Tr. E. „ Sh. I. „ Sh. E.	6 14 7 35 7 46 8 27 9 47 10 11 10 25 12 48	5 16·4
Tues	8	6 19	☽ Moon's First Quarter	1st Ec. R.	7 1 43	5 59·8
Wed	9	13 10 14 6	Occultation of 63 Tauri (6) Reappearance of ditto	3rd Tr. I. 2nd Ec. R. 3rd Tr. E. „ Sh. I.	5 42 7 11 2 8 0 11 11	6 45·4
Thur	10	9 8 9 50	Occultation of m Tauri (5½) Reappearance of ditto			7 33·9
Fri	11	4 50 5 46 5 24 10 44 10 48	Occultation of χ^1 Orionis (4½) Reappearance of ditto Near approach of Moon to χ^2 Orionis (6) Occultation of χ^4 Orionis (5) Reappearance of ditto			8 25·4
Sat	12	12 1 13 2 21 56	Occultation of ζ^2 Geminorum (4) Reappearance of ditto Conjunction of Moon and Uranus, 1° 22′ N.			9 19·8
Sun	13		Illuminated portion of disk of Venus = 0·031 of Mars = 0·999	1st Oc. D.	10 59	10 16·2
Mon	14			1st Tr. I. „ Sh. I. „ Tr. E. 2nd Tr. I. 1st Sh. E.	8 11 9 30 10 24 10 27 11 42	11 13·5
Tues	15	15 28 17 36	○ Full Moon Near approach of Moon to 34 Leonis (6)	1st Oc. D. „ Ec. R.	5 29 8 57 41	12 10·5

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DATE		Principal Occurrences		Jupiter's Satellites		Meridian Passage
		h. m.			h. m. s.	h. m.
Wed	16		Sidereal Time at Mean Noon, 21 45 6·0	1st Sh. E.	6 11	Uranus —
				2nd Oc. R.	7 16	
		6 55	Occultation of *l* Leonis (5)	„ Ec. D.	7 29 19	9 33·9
		7 50	Reappearance of ditto	„ Ec. R.	9 47 9	
				3rd Tr. I.	9 49	
				„ Tr. E.	12 9	
Thur	17	8 29	Occultation of B.A.C. 3996 (6)			
		9 22	Reappearance of ditto			
		15 5	Near approach of Moon to *b* Virginis (6)			9 29·8
		21 7	Conjunction of Mars and Venus, 10° 1′ N.			
Fri	18		Meridian Passage of the Sun, 14m. 9s. after Mean Noon			9 25·7
Sat	19					9 21·7
Sun	20			3rd Ec. R.	7 7 11	9 17·6
Mon	21	14 48	Occultation of η Libræ (6)	1st Tr. I.	10 9	
		15 45	Reappearance of ditto	„ Sh. I.	11 25	9 13·6
Tues	22	6 46	☾ Moon's Last Quarter	1st Oc. D.	7 27	
				„ Ec. R.	10 53 36	9 9·6
Wed	23	3 24	Inferior Conjunction of Venus	1st Sh. I.	5 54	
				„ Tr. E.	6 51	
		18 22	Near approach of Moon to 58 Ophiuchi (5)	2nd Oc. D.	7 32	
				1st Sh. E.	8 6	9 5·5
		23 36	Conjunction of Moon and Saturn, 1° 26′ S.	2nd Oc. R.	9 57	
				„ Ec. D.	10 5 13	
Thur	24					9 1·5
Fri	25			2nd Sh. E.	7 24	8 57·5
Sat	26					8 53·5
Sun	27	10 43	Conjunction of Moon and Mercury, 1° 8′ N.	3rd Oc. R.	6 25	
				„ Ec. D.	9 20 0	8 49·4
				„ Ec. R.	11 9 4	
Mon	28	5 23	Greatest westerly elongation of Mercury, 27° 5′			
		16 45	Conjunction of Moon and Venus, 11° 59′ N.			8 45·4
MARCH		20 40	● New Moon			
Tues	1	23 1	Conjunction of Moon and Mars, 2° 54′ N.	1st Oc. D.	9 26	8 41·4
Wed	2			1st Tr. I.	6 37	
				„ Sh. I.	7 49	
				„ Tr. E.	8 50	8 37·4
				„ Sh. E.	10 2	
				2nd Oc. D.	10 14	

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THE PLANETS FOR FEBRUARY.

At Transit over the Meridian of Greenwich.

Planets	Date	Right Ascension	Declination	Diameter	Meridian Passage
		h m s	° ′		h m
Mercury	5th	20 46 30	−14 10½	10″·2	23 40·9
	20th	20 36 21	17 30	8″·0	22 31·8
Venus	5th	22 47 27	−1 18	52″·5	1 45·4
	20th	22 21 34	1 5½	60″·0	0 20·6
Jupiter	5th	2 41 57	+14 45	37″·1	5 39·3
	20th	2 49 2	15 21½	35″·4	4 47·4
Saturn	20th	17 46 40	−22 11½	14″·4	19 42·6
Uranus	5th	7 22 12	+22 36½	4″·2	10 18·8
	20th	7 20 6	22 40½	"	9 17·7
Neptune	5th	1 6 2	+ 5 16	—	4 3·7

On the 3rd of February **Mercury** passes the meridian at six minutes after noon, and again before the twenty-four hours are completed, that is to say at two minutes before noon on the 4th. The planet is at this time about three degrees above the sun. At the end of the month Mercury is at its greatest distance from the sun to the west, and at this time may be observed in the mornings, before sunrise.

Venus rapidly approaches the sun from the beginning of February until the 23rd, when the planet arrives at inferior conjunction, passing about eight degrees above the sun. At the end of the month the planet passes the meridian about half an hour before noon. This brilliant planet will well repay daylight observation during the month, and should be watched both before and after conjunction, so as to observe the gradual reversal of the crescent, the luminosity of the dark side, the shape of the cusps, &c.

Jupiter is still one of the finest objects in the winter sky; the planet's considerable altitude bringing it so far above the atmospheric disturbances of the horizon as to give the most favourable opportunity for observing the belts, &c. when the weather is clear. It passes the meridian about dusk, and therefore is to be seen in the north-western sky in the evenings.

Saturn is now coming into view again and may be seen in the mornings before sunrise, but will scarcely repay observation at present from its low altitude.

Uranus is very well situated for observation this month, passing the meridian from about half-past 10 at the beginning of February to about half-past 8 at the end.

Neptune may still be observed in the evenings in the western sky.

The few Notes which we give with respect to the planets apply in general to the times when they can be seen in the evening, the night, or the early morning; the telescope, mounted on an ordinary stand, may then be directed to them by means of the finder. Those who possess equatorial instruments may, however, observe the inferior planets, Mercury and

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Venus, at almost any time when they are above the horizon: Venus more especially; indeed this planet, at its greatest brightness, may be found without the equatorial, if its position in the sky is approximately known, even at mid-day. Mars, Jupiter, and Saturn may also be observed by means of the equatorial, when in favourable positions, long after sunrise and before sunset.

LUNAR INFLUENCE.—A correspondent of the *Standard* writes: "Sir,—As during the past year some curiosity has been excited with regard to the moon's influence on the weather, and as this subject has never, to my knowledge, received the notice it deserves, perhaps you will allow me to draw the attention of your meteorological readers to it. The influence of the moon on the sea and ocean has been calculated and settled long ago, but it is otherwise with regard to her influence on the atmosphere of the earth. I have been a practical observer of the weather with regard to the moon for some years with the most accurate instrument science can command, and all my observations have led me to the conclusion that there must be some connection between the two: and I am convinced that on the successful exposition of this theory of lunar influence by gravitation the great enigma of the weather essentially depends. The mechanical reasoning on the subject is of rather a difficult nature, and cannot easily be rendered intelligible without going into it in great detail, and there exists a long chain of cause and effect of too long an interval for any to traverse except those having a good knowledge of meteorological elements at rest and in motion. Some scientific men and some ardent meteorologists have laughed at the idea of the moon exerting any influence on the weather, and unhesitatingly pronounce it 'a pack of nonsense,' but as they were not practical observers of it not much importance can be attached to their opinion. At the opening of the new year many persons will be beginning a fresh weather chart; at a very little trouble it is easily arranged for lunar observation, and in a very short time the most credulous may convince themselves. Take an ordinary weather chart; the one published by Messrs. Negretti and Zambra is the best adapted for this purpose. Call the red line, 29, the equator. From the *Nautical Almanack* point off on the chart the northern and southern declination of the moon on the days she is at her extreme declination. Draw a dotted line from N to S, intersecting the red line called the equator on the day the moon is on the equator; this latter will give the day and time of lunar equinox, or the day the moon crosses the earth's equator, and the curved dotted line will represent the declination of the moon. Next, fix the days of apogee and perigee, and put them in their proper place in declination, then the new and full moons and quarters on their respective days. When this is completed the positions of the moon can be seen at a glance. Sometimes these lunar points or positions are nearly at equal distances from each other, sometimes coincident. It is the coincidence of moon in conjunction in perigee and near the equator that will generally be found to be followed by the most abnormal weather; also moon in perigee and northern declination. Most of the days marked on the chart will be found to be days of some change. A careful observer will soon see the days and periods that precede stormy weather, although it will be at present rather hazardous to risk your reputation as a weather prophet; yet a much clearer insight into the coming weather can be obtained by the aid of this theory than by any other means, particularly at some well-defined periods. Those who wish to know more about it will find the subject fully discussed from page 244 to 256 in Admiral Fitzroy's Weather Book. My own observations

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alone soon yielded results that prove to me almost beyond doubt, that there must be an intimate connection between the moon and the weather, however operating. The results of lunar influence lead to a great variety of intricate and complex questions, each requiring long and patient study, and it is for many reasons difficult to refer weather changes to the moon by a chain of philosophic investigation; but of this I am convinced—the moon is the keystone to the meteorologic arch, and with the light that is thrown on the subject by this theory it is possible now to trace some analogy between what was before a mass of confused and irreconcileable facts and theories, which, for purposes of forecasting weather, is an earnest of ultimate triumph.—Yours, &c., "W. B.

"Deptford, Jan. 4."

ASTRONOMICAL REGISTER—Subscriptions received by the Editor.

To November 1869.

Linwood, Rev. W.

To December 1869.

Bayley, W. H.
Forward, R.
Huggins, W.
Jackson-Gwilt, Mrs.
Metcalf, Rev. R. W.
Nasmyth, J.

To March 1870.

Brothers, A.
Buffham, T. H.
Clodd, E.
Cook, Jas.
Elger, T. G.
Petty, T.
Woodman, T. C.
Wright, W. H.

To April 1870.

Lewis, H. K.

To June 1870.

Alsager, J.
Andrews, W.
Glover, E.
Hubbersty, Rev. R. C.
Jefferies, J.
Jones, Rev. Thos.
Jenkinson, Rev. J. H.
Slater, Jas.
Williams, Prof. M.

To September 1870.

Coulcher, W. M. B.

To December 1870.

Backhouse, T. W.
Bird, F.
Collingwood, E. J.
Cundell, G.
Daw, E.
Davies, Rev. R. P.
Ellis, W. M.
Gilby, J.
Glover, Rev. J. H.
Hannay, R.
Hill, C.
Hunt, G.
Johnson, R. C.
Jones, Rev. E.
Key, Rev. H. C.
Lamb, W.
Perigal, H.
Perrens, J. D.
Redpath, H. S.
Roberson, C.
Smelt, Rev. M.A.
Smyth, Prof. C. P.
Stanistreet, F.
Thomson, Prof. D.
Varley, C.
Vernon, G. V.
Whitbread, S. C.
Wilson, T.
Watson, J.

January 22, 1870. Subscriptions received after this date in our next.

NOTICES TO CORRESPONDENTS.

Many Correspondents write to us to say that their *subscriptions* are not *properly acknowledged*. This may arise from their not having been received until late in the month: we usually close the list about the 20th; subscriptions received after that date being acknowledged in the following number. We must also beg for consideration from those correspondents who send us notice of *alterations of address* late in the month—sometimes even as late as the last day. As our arrangements for posting the *Register* are always made several days before the end of the month, it will frequently happen that these directions cannot be attended to until the following month. *Correspondents' letters* are generally *answered* at the end of the week in which they are received. The Editor trusts, however, that none will feel that their communications are neglected, as it often happens that, from much occupation, he is unable to attend to them when received.—*Post-Office Orders* are to be made payable to S. GORTON, at the *Chief Office, London.*

Several communications are unavoidably deferred.

ERRATA.—Page 15, line 28, for *modules*, read *nodules*; page 16, line 23 from bottom, for *existence*, read *identity*.

The Astronomical Register is intended to appear at the commencement of each month; the Subscription (including Postage) is fixed at **Three Shillings** per Quarter, *payable in advance*, by postage stamps or otherwise.

The pages of the *Astronomical Register* are open to all suitable communications. Letters, Articles for insertion, &c., must be sent to the Editor, Mr. S. GORTON, *Parnham House, Pembury Road, Clapton, N.E.*, **not later than the 15th of the month.**

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The Astronomical Register.

No. 87. MARCH. 1870.

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ROYAL ASTRONOMICAL SOCIETY.

Session 1869–70.

Fourth Meeting, February 11, 1870.

The Annual General Meeting.

J. C. Adams, Esq., F.R.S., *Vice-President*, in the chair.

Secretaries—Mr. W. Huggins and Mr. E. J. Stone.

The Minutes of the last annual meeting were read and confirmed.

The Report of the Council, including that of the auditors, was presented and extracts read. The accounts showed that the funds and property of the Society were in a satisfactory condition. The number of Fellows and Associates, which was 538 last year, was now 557. The gold medal of the Society has been awarded to M. Delaunay for his work on the Lunar theory. Vol. xxxvii. part 1 of the Society's *Memoirs* has been published, containing Major Tennant's Report on the Eclipse of 1868, illustrated by plates from the photographs obtained on that occasion. The Society has lost the following members by death during

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1869:—J. Dickenson, Esq., Capt. Blake, Benjamin Naylor, Esq., John Smith, Esq., Sig. J. Vertu, Rev. C. Walters, Professor Donkin, A. K. Barclay, Esq., and Eddowes Bowman, Esq.

The usual reports from the various observatories have been received. At Greenwich the new Star Catalogue is passing through the press. At Cambridge a new transit circle is nearly completed. Mr. Lassell has re-erected his 2-foot reflector, and finds that the metal speculum, after being laid aside for eight years, protected by a coat of varnish, was in excellent order upon dissolving away the coating with alcohol. Reports from Stonyhurst, Kew, and Mr. Huggins were also mentioned. Mr. De la Rue has made many experiments as to seeing the solar prominences by the use of metallic films, or absorbing liquids, but hitherto without success. He has also revised the method of giving a true parabolic form to his mirrors. Only two minor planets have been discovered in 1869, as against twelve in 1868. The bad weather has doubtless had much to do with this. The planets referred to are (100) Hecuba, discovered by Luther, and (101) Felicitas, by Peters. Three telescopic comets have been observed. The first is known as Winnecke's, and has also been identified as that of Pons 1819, with a strong suspicion that it is also the one seen by Pons in 1806. Comets II. and III. were both discovered by Tempel, of Marseilles. The Vienna Academy has announced a series of prizes for the discovery of telescopic comets between May 1869 and May 1872, not exceeding eight annually; the value to be given either in money or a gold medal. In order to succeed in obtaining a prize the observer must find a comet, telescopic in character, and which is not predicted or expected. Notice must be sent by telegraph if possible, or by post, and the discovery must be corroborated by other independent observations, or a subsequent series by the discoverer. The Council hoped that this encouragement might be suitably rewarded.

The report then gave a list of the forty-four gentlemen who contribute the Ephemerides of the Planets to the *Berliner Jahrbuch*, with the names of the objects for which they are responsible. The solar eclipse of August 1869 was successfully photographed by two expeditions equipped by the United States Government, and also by Commander Ashe. The apparatus used by the American observers was like the instrument Mr. De la Rue took to Spain, but larger; the aperture of the telescope being 6 inches instead of 3·4 inches. The system of enlarging the focal image by an eye-piece was followed, as it gives better definition to the position-wires; but the size of the disc was limited to about 2 inches, instead of nearly 4 inches as given by the Kew Photo-heliograph—the effect being that the pictures

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were beautifully sharp and perfect. The expeditions were organised by Professor Coffin, and placed in charge of Messrs. Morton and Mayer. Six pictures were taken during the totality at Burlington, Iowa; and four at Ottumwa, about 75 miles distant. The former were obtained in from 5 to 7 seconds each, the latter in from 6 to 16 seconds. In Spain, at the eclipse of 1860, from want of knowledge of the actinic power of the prominences, a minute was allowed for each picture. The 1869 pictures, having been taken so much more rapidly, are very perfect indeed. Both series show the same prominences and other surroundings of the solar disc. The spectroscopic observations by Professor Young were of the greatest interest, nine lines having been seen in the prominences. The sky was found to be polarised up to the corona, but the latter was not. In 1868 the light of the corona was strongly polarised. It is hoped the next eclipse will settle this point, and also what the corona really is. Several pictures of the partial phases were taken, one of which shows Baily's beads, and that they are clearly the last glimpses of the sun seen between the peaks of the lunar mountains. Commander Ashe obtained four photographs at Jefferson, U.S., with his 8-inch equatorial, but they are not equal in definition to the others. The Astronomer-Royal has applied his great theoretical and practical talents to the construction of an eye-piece for the correction of atmospheric chromatic dispersion at low altitudes, which promises to be very useful generally, as well as for the special object of the Transit of Venus, which led to its being contrived.

The preparations for observing the Transit of Venus in 1874 are sufficiently advanced to allow of the hope that great additions to our knowledge will then be obtained. The Government will find the necessary funds. Five stations have been selected for the British operations. They will be Kergulen's Land or Crozet Island; Mauritius or Rodriguez; Auckland, New Zealand; Alexandria; and Waihoo. Each will be furnished with a transit and altazimuth, and two equatorials of 6-inches aperture. The French and North German Governments are also moving in the matter, and planning expeditions. The Russian stations are most important, and will doubtless be well attended to. In all the plans uniformity of instruments should, as far as possible, be attended to, and the stations so distributed that risks of failure through bad weather may be avoided. Mr. Proctor's beautiful maps, showing the best available positions for the internal contacts, will be of the greatest value in choosing stations. Dr. Auwers has forwarded a catalogue for the re-observation of all the stars in Argelander's Zones from N.P.D. 10° to 92° down to the 9th magnitude. The work has been distributed among 13

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observers, with the exception of one zone, which remains unappropriated. Dr. Pihl, seeking for employment suitable to a 4½-inch telescope, has devoted himself to the mapping down of the Cluster 34 M., and has laid down the places of 84 stars in it. The subject of spectrum analysis has been pursued by Mr. Lockyer with great diligence and success. He finds sodium, barium, magnesium, and iron, as well as hydrogen, in the chromosphere and its prominences. The motions of this are often violent in the extreme, and from the changes in the refrangibility of one of the hydrogen lines, he has deduced the rate of some of these movements to be 40 miles per second in a vertical direction, and three times as much in the horizontal. Since Mr. Huggins discovered the means of viewing the solar protuberances by means of a wide slit, Professor Zollner has made numerous observations by that method, and depicted most rapid changes in the red flames while under observation. He has also invented a new spectroscope, in which the ray is split, and, passing through separate prisms throwing the rays in different directions, produces two spectra having the colours reversed in order, thus increasing the measured dispersion. Mr. Plummer has applied the spectroscope to the aurora with results confirmatory of Angstrom's observations. The question of the moon's heat has engaged the attention of several observers. Lord Rosse has devoted the 3-ft. telescope to the investigation, and finds some indications of lunar heat; but the greater part is from obscure rays—that is, the heat of the sun has been absorbed, and is afterwards radiated as dark heat. Another observer in France has likewise detected the heat, and finds, like Lord Rosse, that it is purely solar, and not due at all to any internal heat of the moon itself. The experiments of Professor Piazzi Smyth on this subject at Teneriffe were recalled and compared with these results. At Oxford Mr. Main has published the 2nd Ratcliffe Catalogue of Stars, the whole of the work being done by himself and one assistant. A zenith sector for the Indian survey has been completed by Mr. Simms, and has reached its destination. The telescope is of 4-inches aperture, and 4-feet focal length. The sectors are parts of circles of 3 feet in diameter. It is to be used for determining the latitudes of places in Southern India, and will be entrusted to Captain Herschel. The establishment of Mr. Carrington's observatory at Chert, near Farnham, Surrey, was also noticed. It is on a conical hill 60 feet high, having a clear horizon, and requiring no further elevation. It is therefore nearly sunk in the ground, just peeping out of the soil. The clock will be placed in an air-tight case at the bottom of a well 60 feet deep. The principal instrument is an altazimuth on Steinheil's plan, having the telescope for an axis and an external prism.

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The Chairman's Address.

Mr. Adams said that, in consequence of the President's regretted absence from illness, he had been requested to deliver the address on presenting the medal to M. Delaunay, as already announced, for his great work on the Theory of the Moon. Of all problems there is none so attractive as this, the great mathematical difficulties of the subject only acting as a stimulant. The foundation of the theory was laid by Newton in the *Principia*, and although his work was fragmentary, it was most important, and accounted satisfactorily for the motions then known as due to gravitation. During the 18th century the subject was further discussed by Clairaut, D'Alembert, and Euler, and though still far from perfect, the theory accounted for all that was then required. The first tables were made by Meyer, and were of the greatest practical value. The theory was greatly advanced by La Place, who took up the subject of the acceleration of the moon's mean motion, and induced the Academy of Sciences to give a prize in 1820 for the best tables deduced from theory only, former ones having been calculated from both theory and observation. This prize was divided between Plana and Damoiseau and Carlini, all their productions showing immense improvement in our knowledge of the lunar theory. In 1824 Damoiseau published theoretical tables quite as good as those of Buckhardt, founded on the Greenwich observations. The details of these methods were given, and it was shown that Damoiseau assumed certain quantities and ascertained the numerical value of the co-efficients. This was not quite satisfactory, and Plana carried the process further, the numerical elements not being introduced till the end of the formulæ, so that they could be changed when necessary from the progress of science. Plana determined to carry his discussion of the inequalities to quantities of the fifth order, but very often went as far as the seventh or eighth. Soon after Sir John Lubbock tested Plana's results by a different method, and Pontecoulant pointed out some small errors which only showed the wonderful accuracy of the work. By this time Hansen had commenced a new and original investigation of the lunar theory, founded on a process of extensive approximation. The numerical values of the co-efficients obtained by him were exceedingly exact, but depend on numerical elements, for changing which there is no provision. In 1857 his tables were published by the British Government, and have been found better than all others, and are, therefore, exclusively used in compiling the tables for the Nautical Almanack &c. It might have been thought that the subject was exhausted, but our associate, M. Delaunay, was not of that opinion, having in 1846

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commenced his discussion of the theory on a new and original plan, his results being recorded in the volumes published by the French Academy, to their and his honour. He was strongly impressed with the necessity of obtaining the co-efficients in a numerical form, and his results are, therefore, comparable with Plana's. M. Delaunay's method was that of attacking small portions of the work at a time, and thus by successive operations obtaining ultimately the desired results. [Mr. Adams here entered on a detailed account of M. Delaunay's method of proceeding.] In carrying out the principle of conquering by dividing, to get rid of the disturbing functions, he had to perform as many as 505 operations of transformation before they were all removed. This enormous labour has occupied 20 years, during which M. Delaunay has not been assisted by anyone. Indeed, from the very nature of the work, it was not easy to obtain any effective assistance. He has verified his results by doing everything twice over at various times. This is but an imperfect sketch of the labours comprised in the two magnificent volumes published in 1860 and 1867—volumes which are perfect models of order, and where everything will be found in the right place. This work does not include the whole of the lunar theory, but only the perturbations due to the sun, supposing the moon's orbit elliptical. There are still outstanding variations to be discussed and accounted for. Of these, M. Delaunay has since computed the secular acceleration of the moon's mean motion, and that due to the long inequality of Venus. The Council felt that it need not wait for the conclusion of these labours before marking its sense of their value. The work done is complete in itself—it was planned with matchless skill, and carried out with indomitable perseverance, and the Society on its 50th anniversary testifies its highest approval of such exertions. Mr. Adams then, in presenting the medal, added a few sentences in French, conveying to M. Delaunay his sense of the value of his contributions to science, his best wishes for the health and prosperity of the recipient, and the President's regret at not having been able to occupy his proper place on the occasion; to which M. Delaunay replied in a few words.

It was moved by the Rev. F. Howlett, seconded by Mr. C. V. Walker, and resolved:—

That the Report be received, printed, and circulated in the usual manner.

William A. Harris, Esq., was balloted for and duly elected a Fellow of the Society.

The Astronomer-Royal called attention to the fact, that owing, doubtless, to an accidental omission in the wording of the resolution for the reception of the Report, it did not provide for

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printing and circulating the Chairman's masterly address. He thought that Professor Adams was probably the only person in the world who could have produced that address. He (Mr. Airy) was acquainted with many parts of the subject, but had been struck with the Chairman's extraordinary power of discrimination in bringing out the salient points of M. Delaunay's method. The facility and order produced by the plan of breaking up the investigation into separate parts is great in the extreme; the method being founded essentially on taking time as the independent variable. He hoped the proceedings of this day would induce M. Delaunay to undertake the construction of lunar tables founded on his theory. With respect to Hansen's tables, he was bound to say they gave the moon's place better than any preceding tables had done; but Hansen's method was complicated, and although Mr. Adams no doubt understood it to the fullest extent, he (Mr. Airy) could not say he himself did the whole. He concluded by moving that the address be printed and circulated with the Report.

Mr. Lynn, in seconding the motion, said that there was another person who could have written the address, and that was the Astronomer-Royal himself.

The motion was carried unanimously.

Mr. Newall and Mr. Chambers having been appointed scrutineers, the ballot for the election of officers took place, with the following result:—

President.

William Lassell, Esq., F.R.S.

Vice-Presidents.

G. B. Airy, Esq., M.A., F.R.S., *Astronomer-Royal.*
Warren De la Rue, Esq., F.R.S.
Rev. Robert Main, M.A., F.R.S., *Radcliffe Observer.*
Admiral Manners.

Treasurer.

Samuel Charles Whitbread, Esq., F.R.S.

Secretaries.

William Huggins, Esq., F.R.S.
Edward J. Stone, Esq., M.A., F.R.S.

Foreign Secretary.

Lieut.-Col. Alexander Strange, F.R.S.

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Council.

J. C. Adams, Esq., M.A., F.R.S., *Lowndean Professor of Astronomy, Cambridge.*
John Browning, Esq., F.R.M.S.
Thos. W. Burr, Esq., F.C.S., F.R.M.S.
A. Cayley, Esq., M.A., F.R.S., *Sadlerian Professor of Geometry, Cambridge.*
John Henry Dallmeyer, Esq., F.R.M.S.
E. B. Denison, Esq., F.R.S.
Edwin Dunkin, Esq.
George Knott, Esq.
J. Norman Lockyer, Esq., F.R.S.
Captain William Noble, F.R.M.S.
Rev. Charles Pritchard, M.A., F.R.S., *Savilian Professor of Astronomy, Oxford.*
Balfour Stewart, Esq., M.A., LL.D., F.R.S.

It was moved by Mr. Vignolles, seconded by Mr. Browning, and resolved, that the best thanks of the meeting be given to the retiring President, Vice-Presidents, and members of Council.

The meeting then adjourned.

The annual dinner took place in the evening at Willis's Rooms, and in consequence of the interest excited by its being the fiftieth anniversary of the Society, was very numerously attended. The recently elected President, Mr. Lassell, occupied the chair, and gave a short sketch of the history of the Society. M. Delaunay was present and responded to the toast of "Prosperity to the French Academy of Sciences," proposed by the Astronomer-Royal. The election of the Rev. C. Pritchard, ex-President of the Society, as Savilian Professor of Astronomy at Oxford, was noticed, and made matter of congratulation.

THE PARIS OBSERVATORY.—It is with much regret that we learn that M. Le Verrier, the Director of the Paris Observatory, has been compelled to relinquish his post in that establishment from what may be termed incompatibility of temper. That the service of so distinguished an astronomer should be lost to a national observatory from such a cause, is a matter greatly to be deplored; it appears, however, that there was no alternative, as the officers of the establishment were almost unanimous in their determination to resign their appointments unless a change in the directorship were made. We trust that in his successor great scientific acquirements and business habits may be united with urbanity and kindly consideration for others, without which no great establishment such as a public observatory can be conducted with success.

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CORRESPONDENCE.

N.B.—We do not hold ourselves answerable for any opinions expressed by our correspondents.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

THERMOMETER SCALES.

Sir,—I see in this morning's *Times* a discussion with respect to thermometers, and also information (which every schoolboy knows) how to reduce one scale to another.

But as all good foreign thermometers are marked with two scales, viz. Centigrade and Réaumur, it may be useful to your readers to know that they have only to read *both* scales and add 32° and they obtain Fahrenheit immediately, for C. + R. + 32° = F. The same formula applies when any two scales are known for obtaining the third.

Yours, &c.,
EDWIN LAWRENCE.

94 Westbourne Terrace:
Feb. 3, 1870.

D'ARREST'S COMET, 1870.

Sir,—The small periodical comet discovered in 1851 by D'Arrest returns to perihelion in the course of the current year. M. Leveau, of Paris, has prepared an ephemeris, which, month by month, I propose to transcribe for the use of readers of the *Astronomical Register*.

For Berlin Mean Moon.

1870.	R.A. h.	m.	s.	N.P.D. °	′
March 1	15	50	53	92	15·5
3	15	52	48	92	3·47
5	15	54	39	91	51·48
7	15	56	27	91	31·8
9	15	58	11	91	25·46
11	15	59	52	91	11·43
13	16	1	29	90	56·57
15	16	3	2	90	41·30
17	16	4	31	90	25·20
19	16	5	56	90	8·28
21	16	7	17	89	50·53
23	16	8	33	89	32·36
25	16	9	44	89	13·37
27	16	10	50	88	53·56
29	16	11	51	88	33·35
31	16	12	46	88	12·33

The perihelion passage will not take place for some months.

I am, Sir, your obedient servant,
G. F. CHAMBERS.

Windyhills Observatory, Bickley:
February 1, 1870.

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"THE ATHENÆUM" AND THE ROYAL ASTRONOMICAL SOCIETY.

Sir,—The connection of Professor De Morgan with the *Athenæum* is notorious.

It is, further, no secret that, dissatisfied at not being permitted to have his own way in everything, he some years since withdrew from all active participation in the affairs of the Royal Astronomical Society.

Simultaneously with such withdrawal, the Society began to be ignored in the columns of the *Athenæum*, until it has now practically dropped out of them altogether.

Whether these circumstances can fairly be held to stand in the relation of cause and effect, I do not feel competent to decide. There can, however, be no reasonable doubt as to their coincidence and co-existence.

"Tantæne animis cœlestibus iræ?"

10th February 1870. ANOTHER F.R.A.S.

[We see in the *Athenæum* for Feb. 19 a notice of the annual meeting of the R.A.S. on the 11th.—Ed.]

THE ASTRONOMICAL SOCIETY'S LIBRARY.

Sir,—On previous occasions you have opened your pages to grievances of the Fellows of the Royal Astronomical Society; therefore I trust you will allow me to ventilate my grievance, which concerns the state of the Society's library. A late president once publicly lamented, from the chair, that the library was so little used. I ask, How can it be used? My experience is this,—that before I can get a book from the library I am obliged to make five or six fruitless journeys, always to receive from the attendant who opens the door the discouraging reply that "the librarian is not at home." I do not write hastily; it has been the experience of some years; and only respect for the personal character of the librarian has prevented me from addressing you before. Why should he not have an assistant, if necessary? Why should the Society save money every year at the cost of its efficiency? I maintain that the library should always have an attendant; not a very unreasonable request. To many people, including myself, a visit there means a considerable expenditure of time and some money. I have often been obliged to purchase a book rather than get it from the Society, owing to the numerous disappointments I have had.

Again, through the instrumentality, I believe, of your Journal, a small room was set aside for periodicals, &c. I should like to know how people can read in a room with the temperature just above freezing. I do ask that there may be a fire there during the winter months. It should be the aim of the Society to encourage study, not discourage it.

Yours obediently,

GRUMBLER.

THE ECLIPSE OF DECEMBER NEXT.

Sir,—Can you inform me if any facilities will be given to amateur astronomers to view the total eclipse of the sun in Spain next December? If it were so, I and certain friends of mine would proceed there. I certainly believe that if the Peninsular and Oriental Company were to issue cheap tickets to Gibraltar, it would induce many to go, and would prove remu-

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nerative. I wish the subject could be brought before the directors of that Company. A total solar eclipse is such a rare phenomenon, and as none can be seen in Great Britain in the lifetime of anyone now alive, I am sure many lovers of astronomy would wish to proceed where this treat can be obtained.

February 1870. A CONSTANT READER.

THE OBSERVING ASTRONOMICAL SOCIETY.

REPORT OF OBSERVATIONS MADE FROM NOVEMBER 7, 1869, TO JANUARY 6, 1870, INCLUSIVE.

Jupiter.

Sir,—Mr. T. W. Backhouse observed the eclipse of Sat. I. on November 6. "At 9h. 19m. 10s. it had commenced to grow faint, and was almost in contact with Jupiter. At 9h. 21m. 0s. it disappeared." He also witnessed the partial transit of Sat. III. on November 15. "More than a quarter of an hour elapsed after its first contact with Jupiter, before it was entirely upon the disc." At 10h. 23m. the Sat. had completed half its ingress. "It was so far south that I could never, during the transit, see any space between it and Jupiter's S. limb, and at 11h. 1m. 45s., when it was half-way across, it appeared as a white circle at the S. pole of the planet." At 11h. 0m. 30s. fully half its shadow was on Jupiter. "The air was not favourable." On November 19 Sat. II. was occulted. "It came into contact with the planet at 10h. 25m. 35s., was half obscured at 10h. 28m. 5s. and ceased to be visible at 10h. 30m. 25s. December 14. Transit of Sat. I. Ingress, first contact at 9h. 49m. 0s., half on the disc of the planet at 9h. 51m. 0s., and internal contact at 9h. 53m. 20s. December 28. Transit of Sat. III. From 6h. 56m. to 7h. 0m. it seemed to be in internal contact with Jupiter, as a white circle against the dusky background of the planet. Owing to the greater brilliancy of the *p* side of Jupiter, it was invisible during the latter half of the transit." The last contact at egress occurred at 8h. 44m. Mr. Backhouse adds:—"The dusky equatorial region of the planet looks orange; not so the polar regions."

Mr. Edmund Salter, of Manchester, examined this planet with his 12-in. silvered-glass reflector, and he says:—"November 15th, 10h. 16m., observed the transit of Jupiter's 3rd Satellite. The weather was fine throughout, so that the Sat. remained conspicuously visible during its entire passage across what may be called the antarctic circle of its primary. The shadow was densely black, and larger than the satellite. At the same time the belt scenery presented by Jupiter was really magnificent. The power used was 320, and with it the whole disc presented an expanse of graduated and glowing colours. The great equatorial S. belt was easily seen to be double, being divided by a light streak of varying breadth. Its colour was a rich *tawny*. The less prominent belts N., near the equator, were similarly tinted but with less intensity. The light bands, separating the belts, were a clear and bright primrose yellow. The polar regions of the planet seemed shaded with a faint ashy blue, with indications of numerous narrow belts. A thickening of the S. edge of the great belt was perceived, also two minute dark specks on its margin, about one-tenth of the planet's diameter asunder. A much stronger and irregular thickening of the S. edge of one of the belts below the equator was very conspicuous indeed; also, many variations in depth of tint were discernible generally."

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Mr. James Cook, of Preston, writes:—"I detected the colour in the belts as soon as I had completed a total refraction prism in October last, but from what Mr. Webb says ('Cel. Obj.,' p. 128), I concluded the colour was nothing new. It appears, in its present intensity at least, to be not the colour noticed by Secchi, from what Mr. Browning says in his paper. I could not follow the transit of Sat. I. on November 30 throughout, but could see both moon and shadow well when a little more than half-way across the disc."

Mr. Henry Ormesher witnessed several eclipses and occultations of the Satellites, and the following are the exact times of occurrence:—

				h.	m.	s.
1869.	November	22.	I Sat. Ec. R.	9	48	—
	December	3.	III Sat. Oc. D.	6	16	—
		„	III Sat. Oc. R.	8	7	—
		„	III Sat. Ec. D.	8	53	30
		„	III Sat. Ec. R.	10	40	57
		6.	I Sat. Oc. D.	10	46	30

On November 30 and December 6 he observed two dusky spots on the disc of the planet.

Mr. Reginald Forward writes:—"As the question as to whether the shadows of Jupiter's satellites have a penumbra seems to be exciting some interest, I beg to enclose you a rough copy of a sketch I have in my note-book of the transit of the shadow of Jupiter's 3rd Satellite, on the evening of the 3rd of October last. You will see that it has a penumbral surrounding. On first observing it I thought the telescope must be out of focus or the mirrors out of adjustment, but having ascertained that such was not the case, and as it was a phenomenon I had never before witnessed, I thought it worth while to make a note of it. It had very much the appearance of the penumbra of a solar spot. The shading was more conspicuous towards the southern portion."

Meteors.

Mr. T. W. Backhouse, of Sunderland, says:—"On November 6 I saw 21 meteors, of which 12 had a well-defined radiant point at R.A. 3h. 37m. N. declin. 16°. Of the 10 meteors I saw on the 4th (as already reported) 4 agree with this radiant point. Many of these 16 meteors were very faint; the brightest had short sparkling trains. None of the meteors on either the 4th or the 6th belonged to the great November shower. On the night of November 13 the weather was very cloudy, and I saw the sky partially clear for 10 minutes only. During this interval I saw 3 meteors—two belonging to the shower, and the other unconformable."

Observers agree in stating that during the nights of November 13 and 14 the sky was nearly completely overcast.

Mr. Edmund Salter writes that "three meteors, one of them considerable, were observed during the evening of December 3. One just grazed the field of the telescope, darting in *zigzag* direction, apparently from near Capella, and disappearing about 20° degrees below Jupiter."

On December 25 the Rev. S. J. Johnson observed a "brilliant meteor. Time 7h. 14m. Meteor crossed the N. part of Cygnus, and continued in view two seconds. It left a wide train which extended over 20° of space. I did not notice any meteors about January 1–4th."

Aurora Borealis.

Mr. Thos. G. E. Elger, of Bedford, reports that "an unusually fine auroral display was observed here on the evening of January 3. Shortly

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after 6h. a deep crimson glow overspread the northern sky, and numerous streamers, apparently convergent, shot up from the horizon; at 6h. 20m. a very bright and persistent ray extended as far as β Draconis. A lull then ensued which lasted till 6h. 31m., when other streamers, brighter than the first, but not so decidedly ruddy in hue, succeeded; one of these bright beams was at least 4° in breadth, and could be traced to γ Ursæ Minoris. Between 6h. 30m. and 6h. 40m. the glow became more intense, and many streamers, alternating with dark streaks, were noted. At 6h. 45m. the appearance of the sky was magnificent, the deep red glow forming a fine contrast with a few scattered black clouds which had drifted from the S.W. over the northern horizon. At 7h. 5m. the crimson colour gave place to a subdued hue of creamy white, and the streamers increased in number; a notable one was remarked in the N.N.W. at 7h. 8m., which appeared to be about 2° in breadth, and could be traced through Cassiopeia nearly to the zenith. At 7h. 20m. the sky was partially overcast; ill-defined patches of cloud stretching across the northern quarter; between these the glow assumed the deep crimson hue remarked during the early part of the display, while above and below the auroral light retained its dawnlike appearance. No traces of arch or corona were observed, and had it not been for the streamers the aurora might have been easily mistaken for a large fire in the neighbourhood. The azimuthal limits of the glow were from N.W. to N.E.; and some idea of its intensity may be gathered from the fact that, during the height of the display, the light of the brightest stars between the northern horizon and 40° of altitude was obliterated. The glow continued to be visible till 10h., but no streamers were observed after 7h. 15m."

The Rev. S. J. Johnson writes:—"On the night of January 3, at 8h. 15m., I noticed the heavens were illuminated by a brilliant display of the Aurora Borealis. The earlier part of the evening had been very clear, but it had become overcast before 8h. Through an opening in the clouds in the N.E. there was a very bright mass of light, which extended over a space of about 20°. From this the usual pale streamers of the aurora kept shooting upwards. The clouds soon gathering together I was not able to obtain another sight, but from the brightness of the sky when the clouds were somewhat thinner, I imagined the display must have been a very fine one."

The Trapezium in Orion.

Mr. Edmund Salter examined this interesting object with his 12-in. silvered-glass reflector on the night of December 3rd, and he says:—"In the trapezium 9 stars certainly, 10 probably, were visible. A youth of 15 saw the 9 immediately on placing his eye to the instrument, though his attention was solicited only to the 4 large stars and to the star ε or the 5th. He was confident as to the 10th, which he saw by glimpses."

The Lunar Crater Plato.

The lunar crater Plato has been observed by members of the Society, and the observations forwarded to Mr. W. R. Birt, who reports that our knowledge of the walled plain, Plato, has been considerably augmented since the formation of the Society. Much of this knowledge has resulted from the labours of Mr. Gledhill, of Mr. Crossley's observatory, Halifax, and of our own members, Mr. Cook, of Preston, Mr. Birmingham, of Tuam, Mr. Elger, of Bedford, and Mr. Pratt, of Brighton. Mr. Pratt has discovered six spots on Plato, and determined the *triplicity* of Dawes' double spot, and Mr. Elger has discovered two spots on the floor. The mean number of spots visible in ordinary state of the earth's atmosphere is

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7; the largest number yet observed on any one evening is 18. The spots most usually seen are Nos. 1, 3, 4, 5 and 17 of Mr. Birt's list of 32. All the earlier spots discovered by Gruithuisen, Mädler, Challis, Dobie, and Knott have been re-observed, and there is good reason to believe that most of them are permanent, although intermittent in visibility.

Solar Spots.

Mr. Henry Ormesher has forwarded me two sketches of a large spot that was visible on the sun on November 19th and 20th. The penumbra which surrounded this spot enclosed three umbræ, and in one of these umbræ a nucleus was plainly apparent. It was of an oval form, and much darker than the umbræ.

I am, dear Sir, truly yours,
WILLIAM J. DENNING,
Hon. Sec.

Ashley Road, Bristol.

BRIEF CORRESPONDENCE.

AN EXTRAORDINARY METEOR.—About seven o'clock, the evening being very clear, and the stars bright, a brilliant white meteoric tail shot across the sky, from west to east, but, unlike ordinary meteors, this remained visible for about twenty minutes, and when the first tail began to grow dim a second tail shot out at an angle towards the north, of equal length with the first, but, instead of the light being in one continuous stream, it had a mottled appearance, like a "mackerel sky." The first tail commenced just underneath Markab, the bottom star in the square of Pegasus, which was then near the horizon, and passed considerably beyond the zenith; the second, passing through Cygnus, reached as far as Cor Caroli. I am led to the opinion that it was a meteor entangled in the atmosphere of the earth, from the fact that I distinctly saw the second tail moving as though shaken by the upper current of air; and that the weather, which before had been remarkably fine, suddenly became stormy, the wind becoming very boisterous immediately after the disappearance of the meteor. I shall be glad to hear from some astronomical correspondent on the subject, for if it was a meteor (as popularly understood) it was, in all probability, the largest ever seen; and if a lunar rainbow, a very remarkable one. —C. E. Kettle, Royal Laboratory, Woolwich, Feb. 3. (*Standard.*)

SPOTS ON THE SUN.—Yesterday and to-day, being the first clear, cloudless, although bitterly cold days that we have had in this neighbourhood, I was enabled to turn my telescope towards the sun. He is covered with a profusion of spots, there appearing to be on the hemisphere which he presents to us this day at least seven groups of them, each group comprising several individuals. Yesterday I sketched a connected group of unusual size, which must be, I venture roughly to estimate, at least 60,000 miles across, and from 6,000 to 10,000 miles broad in the broadest portion. It was then remarkable for the extent and irregularity of the penumbra as compared with the nuclei or umbræ of the different parts; also for an apparent insertion of fragments of the photosphere into the midst of one nucleus and one penumbra respectively. To-day I observe that while the spot maintains a general resemblance to its form of yesterday, it betrays the presence of cyclonic action, which seems to have spent its force, so that,

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while the spot will probably be visible for eight or ten days longer, it will also probably be not so large as at present. On the eastern rim of the sun a spot is making its appearance, which as it advances towards the centre of the disc will be an important spot with regard to size. It is hardly needful to remind your scientific readers that we are approaching the period of a maximum in the sun spots, and that their formation, which is supposed to be due to planetary action, and mainly to that of Venus, is to us interesting, because it is thought to affect the magnetism of the earth.—Jonathan Bates, Kirstead Rectory, Brooke, Norwich, Feb. 10. (*Standard.*)

THE CENTURY.—To "H. O."—I am reluctant to occupy space by discussing the old "century question." A notice of it may be found in Lardner's "Museum of Science and Art," vol. 7, pp. 6, 7. See also Herschel, "Outlines," p. 680, art. 927, 5th ed. Eastern story tells of certain rebellious Afrites who were shut up in brass bottles by Solomon, sealed with his signet, and thrown into the sea. Every now and then one of them was fished up, and when opened a volume of smoke issued, which became condensed into an Afrite, who, imagining that Solomon was still living, exclaimed, "Repentance! O Prophet! we will not return to the like conduct ever!" Thus, certain controversies, once seemingly effectually disposed of, turn up again. Somebody, unfortunately, removes the stopper, and there follows something suggestive of the cloud of smoke, and the rising portentous form of the liberated genie. Only we hear no cry of repentance; and not possessing a spell like that of the mystic signet-ring of Solomon, such suspicious-looking bottles might better be thrown back unopened into the sea! G. J. W.

"THE CENTURY QUESTION."—This seems hardly to admit of any "question" at all. That we are now in the 19th century is plain enough from the fact that 18 complete centuries, plus 69 years and a few weeks, have elapsed since the commencement of our era. But to ask whether we are now in the 70th or the 71st year of the present century, is only to ask whether or not 70 complete years have run out since the 1st of January 1801. There have certainly been persons found to dispute when the present century *did* begin!—whether at the close of the year 1799, or one year later; but a moment's reflection ought to suffice for all who are not prepared to deny that there are neither more nor less than one hundred years in a century. R. J. G.

MINOR PLANETS.—I am much obliged to G. J. W. for the positions of the minor planet Ceres in December last, which I was able to observe distinctly with my 3-inch refractor. May I trouble G. J. W. to inform me if any of the other four minors whose places are given in the *Nautical Almanac* are visible at present? I should be glad to see the positions of a few of the asteroids occasionally announced in the *Astronomical Register*. W. T. HOLDEN.

ZETA BOÖTIS.—What is the present distance of ζ Boötis? I can just divide them now with my dialyte of 5.5in. aperture, and a power of 387, which shows 36 Andromedæ widely separated. H. I.

THE SUN IN THE ECLIPTIC.—To "TYRO."—That the sun is longer in traversing the six northern signs of the ecliptic than the other half of it, was discovered by Hipparchus. Our summer (understanding by this, the time between the vernal and autumnal equinoxes) is about 7½ days longer than our winter, or the time between the autumnal and vernal equinoxes. The reason is, 1. Because the ellipse of the earth's orbit is divided by the

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line of the equinoxes into two unequal segments. 2. Because the earth is more distant from the sun during the former of the above periods, and moves slower. This state of things has not always been, nor will always be so. Both the line of the equinoxes and that of the apsides, or the major axis of the earth's orbit, are slowly shifting their position, so that this inequality of the seasons goes through a cycle of variations, measured by many thousand years. The thing may be more concisely put, by stating that the perigee of the sun's apparent orbit has a progressive motion which necessitates a continual variation in the relative lengths of the seasons. This motion, 61″·7 in a year, has been very different in different centuries. At the beginning of A.D. 1800 the perigee was 99½° from the autumnal equinox. According to Le Verrier, the two points were in approximate coincidence 30,000 years earlier. (See Guillemin, "The Heavens," pp. 120, 121; Herschel, "Outlines," &c., p. 234, art. 369*b*, 5th ed.; Chambers' "Descriptive Astronomy," p. 67. G. J. W.

THE ECLIPTIC.—What "A Tyro" has heard stated concerning the sun being longer in the northern than in the southern half of the ecliptic, is quite true. The cause depends upon the fact that the line of apsides of the earth's orbit is subject to a direct annual change of 11·29,″ independent of the effect of precession, so that, allowing for the latter cause of disturbance, the annual movement of the apsides may be taken at about 1′. Particulars on this point will be found in most astronomical treatises of any pretensions. G. F. C.

COLOURED STARS.—In the strict sense of "P.'s" enquiry no list of coloured stars of any degree of completeness exists, but Smyth's "Cycle" and Webb's "Common Objects" refer to most of the noticeable coloured stars, whilst Chambers's "Astronomy" contains a full selection of red and orange stars. F.R.A.S.

COLOURED STARS.—To "P."—I never heard of any complete list of coloured stars. As far as I know, the sources of information are Smyth's "Cycle," *passim*; "Speculum Hartwellianum," and "Sidereal Chromatics," by the same. There is a catalogue of *red* stars in "Chambers." G. J. W.

NEPTUNE.—To "LANCE."—Smyth speaks of Neptune thus: "In the Hartwell telescope (6-in. aperture) it is a well-defined circular body, with a steady, pale, greyish tint; but I certainly did not fully appreciate the grandeur of this *ultima thule* until I saw both him and his satellite in Mr. Lassell's gigantic equatorial at Liverpool on a beautiful night in September 1856. I was then, indeed, awed, for the object was grave and suggestive."—*Spec. Hart.* p. 89. G. J. W.

NEPTUNE.—Almost any telescope will enable one to discriminate between Neptune and a star; but I should suggest an aperture of 3 inches as the minimum that would make Neptune conspicuously noticeable as not a star. X. Y. Z.

SOLAR SPECTRUM.—The fine coloured representation of the Solar Spectrum, mentioned in the *Astronomical Register* of January, p. 1, can be obtained from Mr. Ladd, 11 and 12 Beak Street, Regent Street, W., price 7*s.* 6*d.* Fraunhofer's 7 lines, and a few more, are lettered. Upwards of 500 lines can be counted with the help of a magnifying glass. The curve of luminous intensity is also drawn. The diagram would have been still more perfect if the curves of thermal and chemical intensities had likewise been marked. G. J. W.

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OBITUARY.—We have to notice with regret the sudden death, on the 1st of last month, of *Professor Brayley*, the librarian at the London Institution, the readers at which place will much miss his ready attention to their wants. He was a Fellow of the Royal Society, and also of the Astronomical Society, and was well known for his communications to many of the scientific periodicals, also for his lectures on the Constitution of the Sun and on other subjects. He was one of the supporters of the *Astronomical Register* from the first. Another of our old subscribers, *Mrs. Janet Taylor*, is just dead. She was known as a mathematician of great acquirements.

THE PLANETS FOR MARCH.

AT TRANSIT OVER THE MERIDIAN OF GREENWICH.

Planets	Date	Right Ascension	Declination	Diameter	Meridian Passage
		h m s	° ′		h m
Mercury	4th	21 23 13	−16 22	6″·6	22 31·3
	20th	22 51 28	9 45½	5″·4	22 56·4
Venus	4th	21 54 22	−3 50½	57″·0	23 2·4
	20th	21 50 44	6 57	45″·6	21 55·9
Jupiter	4th	2 56 15	+15 56	34″·4	4 7·4
Saturn	4th	17 49 51	−22 11½	14″·6	18 58·6
	20th	17 52 40	22 11½	15″·0	17 58·5
Uranus	4th	7 18 54	+22 42½	4″·2	8 29·3
	20th	7 18 5	22 43½	4″·0	7 25·5

Mercury may be seen in the morning at the beginning of March, rising before the sun; on the 1st of the month the planet passes the meridian about an hour and a half before noon. This interval gradually decreases up to the end of the month, when it amounts to 35 minutes only.

Venus passes the meridian about three-quarters of an hour before noon, at the beginning of the month, and about two hours and a half before noon at the end of March. The planet may be well seen before sunrise, and is now an excellent object for the transit instrument in the mornings. Its greatest brilliancy occurs at the end of the month, when, as in January, it may be seen without optical assistance in the daytime, if its precise position is known.

Jupiter may still be seen in the evenings, in the western sky, his large northern declination being favourable to observation.

Saturn may be observed in the morning in the south-east.

Uranus is still well situated for observation.

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ASTRONOMICAL OCCURRENCES FOR MARCH 1870.

DATE		Principal Occurrences		Jupiter's Satellites		Meridian Passage
		h. m.			h. m. s.	h. m. Uranus
Tues	1	20 40 23 1	Sidereal Time at Mean Noon, 22 36 21·2 ● New Moon Conjunction of Moon and Mars, 2° 54′ N.	1st Oc. D.	9 26	8 41·4
Wed	2		Meridian passage of the Sun, 12m. 20s. after Mean Noon	1st Tr. I. „ Sh. I. „ Tr. E. „ Sh. E. 2nd Oc. D.	6 37 7 49 8 50 10 2 10 14	8 37·4
Thur	3			1st Ec. R.	7 18 22	8 33·3
Fri	4			2nd Sh. I. „ Tr. E. „ Sh. E.	7 39 7 42 10 3	8 29·3
Sat	5					8 25·3
Sun	6			3rd Oc. D. „ Oc. R.	8 21 10 42	8 21·3
Mon	7	5 15	Conjunction of Moon and Jupiter, 4° 13′ N.			Moon 3 55·1
Tues	8		Saturn's Ring: Major Axis = 36″·89 Minor Axis = 16″·44			4 39·3
Wed	9	23 8	Conjunction of Venus and Mercury, 9° 51′ S.	1st Tr. I. „ Sh. I. „ Tr. E.	8 36 9 45 10 49	5 25·7
Thur	10	1 12	☽ Moon's First Quarter	1st Oc. D. „ Ec. R.	5 56 9 14 8	6 14·8
Fri	11	1 28	Conjunction of Mercury and ι Aquarii (4m·6) E.	1st Sh. E. 2nd Tr. I. „ Sh. I. „ Tr. E.	6 26 8 3 10 18 10 29	7 6·5
Sat	12	6 38 6 40	Conjunction of Moon and Uranus, 1° 16′ N. Conjunction of Mars with the Sun			8 0·6
Sun	13	16 4	Occultation, disappearance of δ Cancri (4)	2nd Ec. R.	6 54 8	8 56·3
Mon	14					9 52·6
Tues	15		Illuminated portion of disk of Venus = 0·118 of Mars = 1·000			10 48·8

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DATE		Principal Occurrences		Jupiter's Satellites		Meridian Passage
		h. m.			h. m. s.	h. m. Moon —
Wed	16		Sidereal Time at Mean Noon, 23 35 29·5	1st Tr. I.	10 36	11 44·3
Thur	17	1 52	○ Full Moon.	3rd Sh. I. 1st Oc. D. 3rd Sh. E.	7 19 7 56 9 25	12 39·2
Fri	18		Meridian Passage of the Sun, 8m. 12s. after Mean Noon	1st Sh. I. " Tr. E. " Sh. E. 2nd Tr. I.	6 9 7 19 8 21 10 50	Uranus — 7 33·5
Sat	19					7 29·5
Sun	20			2nd Ec. R.	9 30 35	7 25·5
Mon	21	17 15	Near approach of Moon to χ Ophiuchi (6)			7 21·6
Tues	22	14 19 15 9	Occultation of ξ Ophiuchi (5) Reappearance of ditto			7 17·7
Wed	23	7 43 16 37	Conjunction of Moon and Saturn, 1° 6′ S. ☾ Moon's Last Quarter			7 13·8
Thur	24	16 11 17 7	Occultation of B. A. C. 6607 (6) Reappearance of ditto	3rd Tr. I. " Tr. E. 1st Oc. D.	7 17 9 38 9 57	7 9·8
Fri	25			1st Tr. I. " Sh. I. " Tr. E. " Sh. E.	7 6 8 4 9 19 10 16	7 5·8
Sat	26			1st Ec. R.	7 34 23	7 1·9
Sun	27	21 59	Conjunction of Moon and Venus, 7° 30′ N.	2nd Oc. D.	7 53	6 57·9
Mon	28		Saturn's Ring: Major Axis = 38″·13 Minor Axis = 16″·95			6 54·0
Tues	29			2nd Sh. E.	7 17	6 50·1
Wed	30	6 6	Conjunction of Moon and Mercury, 2° 21′ N.			6 46·2
Thur	31	1 25 13 58	Greatest brilliancy of Venus Conjunction of Moon and Mars, 4° 17′ N. ● New Moon			6 42·2

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METEOROLOGY.—The Meteorological Department of the Board of Trade is making good progress under the direction of Mr. R. H. Scott. Seven observatories, established and maintained in different parts of the United Kingdom at the public expense, are all in good working order, and transmit their self-recorded results monthly to the central establishment. By March next, the President of the Royal Society states, the numerical results from every one of those observatories will be published. The Meteorological Department is superintended gratuitously by a Committee of the Royal Society. The Drum Signal is now hoisted at more than one hundred British Stations, and communication of weather disturbance is telegraphed from these islands to all the coasts of the Continent, from whence similar information is received.

NEW EDITION OF SMYTH'S CYCLE.—In answer to a correspondent, we can only say we have no information as to when the new edition of this celebrated work will be ready; we can only advise patience!

ASTRONOMICAL REGISTER—Subscriptions received by the Editor.

To December 1869.

Aldam, W.
Darby, Rev. W. A.
Hickson, W. E.
Lancaster, J. L.
Lancaster, W. L.
Tupman, Capt.

To March 1870.

Blacklock, A.
Elliott, R.
Guyon, E.
Hemming, Rev. B. F.
Toy, E. P.

To April 1870.

Knobel, E. B.

To May 1870.

Ormesher, H.

To June 1870.

Fleming, Rev. D.
Gooch, Miss
Holden, Rev. W. T.
Monk, Dr.
Radford, Dr.
Rump, H. R.
Ryley, F. B.

To December 1870.

Barber, J. T.
Baxendell, J.
Bridson, J.
Clermont, Lord
Erck, W.
Gould, Rev. R. I.
Lee, I.
Parnell, J.
Stothard, Dr.
Worthington, F.

February 23, 1870. Subscriptions received after this date in our next.

BOOKS, &c. RECEIVED.—"Discussion of the Meteorological and Magnetical Observations made at the Flagstaff Observatory, Melbourne, during the years 1858–1863, by George Neumayer, Ph.D.—Also an interesting Paper "on Comets and Meteors," by Professor Daniel Kirkwood, of the Indiana University, read before the American Philosophical Society, Nov. 19, 1869.—Also Papers "on the Reform of Astronomy;" "The Moon's Axial Rotation;" "The Earth does *not* orbitate round the Sun;" "Revolution and Rotation;" "Conics;" and "Planetary Orbits:" by H. Perigal.

NOTICES TO CORRESPONDENTS.

Communications for insertion must *in all cases* be authenticated by name and address, not necessarily for insertion, but for the information of the Editor.

We have in preparation a series of careful Observations of Jupiter, made at Mr. Crossley's observatory, Halifax, by Mr. Joseph Gledhill, with an equatorial refractor by Cooke, of $9\frac{1}{2}$ in. aperture.

The Astronomical Register is intended to appear at the commencement of each month; the Subscription (including Postage) is fixed at **Three Shillings** per Quarter, *payable in advance*, by postage stamps or otherwise.
The pages of the *Astronomical Register* are open to all suitable communications. Letters, Articles for insertion, &c., must be sent to the Editor, Mr. S. GORTON, *Parnham House, Pembury Road, Clapton, N.E.*, **not later than the 15th of the month.**

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The Astronomical Register.

No. 88. APRIL. 1870.

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ROYAL ASTRONOMICAL SOCIETY.

Session 1869–70.

Fifth Meeting, March 11, 1870.

W. Lassell, Esq., F.R.S., *President*, in the chair.

Secretary—Mr. E. J. Stone, F.R.S.

The Minutes of the last ordinary meeting were read and confirmed.

Sixty-two presents were announced (including the second Radcliffe Catalogue of 2,386 Stars), and the thanks of the Society voted to the respective donors.

Charles Meldrum, Esq., and
Charles Watson, Esq.,

were balloted for and duly elected Fellows of the Society.

The following papers were read:—

Ephemeris of the Satellites of Uranus: by Mr. Marth.

This paper contained the position angles, and distances of the 4 Satellites Ariel, Umbriel, Oberon, and Titania, from February 18 to April 8. It was ordered to be at once printed and circulated.

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Dark Objects crossing the Sun's Disc: by Lieut. Herschel.

In a letter received by his brother, Professor A. Herschel, the Author detailed a remarkable appearance which he witnessed at Bangalore, in India, on the 17th and 18th October last. On the morning of the 17th Lieut. Herschel, proposing to observe the sun with the 5-foot telescope and spectroscope, first projected the sun's image on a white card, to see what spots were visible. He then noticed a number of dark shadows crossing the sun's disc, and a number of bright objects outside the sun. His first impression was that the appearance resulted from birds flying past, but upon the sun's image being drawn on a slate and the direction of the spots marked upon it, they were found to be passing at the rate of 30 or 40 in a very short time. The clock was then set going, and the screen with the sun's disc moved in accordance, when a great number of paths were drawn across it, all fairly coincident in direction. The shadows were seen in the finder also, and looking through the tube as ill-defined sparks crossing the sun's border. Next morning the bodies were seen again crossing the disc in two streams. With the solar focus they were badly defined, but, altering the focus to that of distant clouds, they were improved. As they approached the sun they became brighter, and less vivid as they receded from it. Their motion was irregular, but still pretty constant in direction and velocity. One only was seen to retrograde, and that was doubtful, though the paths were occasionally contorted, like floating particles subject to many currents. About 15 to 20 per minute passed the sun's disc. Their shape was uncertain. At first they appeared like the half-moon with the diameter forward, but afterwards as a double crescent with a bar across and rings accompanying. The spectrum was solar, filling the slit with vivid flashes from top to bottom. As the sun got lower and could be viewed without a diagonal reflector, one of the objects was observed to pause, stand steady for a second, and then whisk off; and it then became clear that they were locusts, flies, or other insects at a great distance. Next morning the stream continued, so that it is a wonder of natural history, if not of astronomy. When the mail left the papers contained an account of a great flight of locusts at a distant part of the country, and a famine in consequence. Similar occurrences have been observed before, and during the last American eclipse observations, some appearances of the same character had been noticed.

Mr. Stone thought the paper useful in an astronomical point of view. There had been numerous accounts of such bodies being seen, but the observers did not take the precaution to shift the focus, which would have shown their true nature.

Capt. Noble referred to the case of some bodies puzzling the Rev. W. Read, by passing his telescope, which mystery was

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solved by Mr. Dawes focussing on them, and showing they were thistle or dandelion seeds.

Occultation of m Tauri: by Captain Noble.

This took place on February 10, 1870, but the observation was not very reliable.

Observations of Venus near her Inferior Conjunction: by Capt. Noble.

The day of absolute conjunction, February 23rd, was densely clouded; but on the day before (22nd), when the planet was within 24 hours 14 minutes of conjunction, the author observed Venus as an extremely fine line of light not quite round a circle — the unilluminated chord being less than a diameter. Not having a Dawes eye-piece, he made a hole in a card diaphragm with a red-hot needle, and then saw the dark body of the planet distinctly against the light of the sky, but the circle was not quite complete.

Observations of the Zodiacal Light: by Capt. Noble.

On March 3, 1870, the zodiacal light was brighter than the author had ever seen it before, surpassing the brightest part of the Milky Way in Cassiopeia and Cygnus, which was visible near it. The cone of light included the stars α, β, and γ Arietis, but not the Pleiades, which were separated from it by a clearly-marked piece of sky. Notwithstanding books lay down that the light follows the course of the ecliptic, or very nearly so, on the present occasion it departed widely from that direction to an extent which was estimated at 20° at least.

On Further Changes in the Coloured Belt of Jupiter: by Mr. Browning.

The author exhibited a large drawing of Jupiter, with the colouring to which he had drawn attention. It had lately undergone much change, the coloured part being only the northern half of the equatorial belt, so that it was more correct to say there were two belts—the southern a pure white, the other yellow but more dim than before. This white belt was the only part quite free from colour. His last drawing was on January 30, 1870, at 9h. 30m., but the planet was then very low. The dark belts were imperfectly formed and not well defined. The colouring again covered the whole of the equatorial belt, and there were other changes. The colour over all the equatorial belt was tawny yellow. South of this was a very dark band, and a narrower one on the north. Above each of these was a narrow bright white belt. The outbreak of colour, therefore, appears to be on the increase. The planet should be carefully observed by all astronomers having a westerly look-out, and with the Astronomer-Royal's new eye-piece to counteract the low elevation.

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The President was astonished at the great breadth of the equatorial belt as shown in Mr. Browning's drawings. It was half as broad again as generally seen.

Capt. Noble asked whether the festoons along one margin of this belt, formerly visible, had disappeared.

Mr. Browning could not say. He did not see them then, and always drew exactly what he saw only.

Mr. Stone mentioned a curious effect of different powers in observing an eclipse of Jupiter's third satellite last Sunday week. He was using a power of 600, and was struck by the great faintness of the planet, and put on a lower one to view it well. He then again used the high power to observe the eclipse, which he witnessed, and returning to the low power, found the satellite still visible, and saw it again put out.

On the Corona visible in Solar Eclipses: by Mr. Proctor.

In this paper the author dwells on some of the important characteristics of the corona, which show that it cannot possibly be a terrestrial phenomenon, a view which has lately been somewhat advocated. The first argument in favour of the conclusion that the corona cannot be connected with our atmosphere is derived from the fact that the moon appears as a perfectly black disc in the sky, showing that the light forming the corona is behind it, whereas, on the other theory, had it been due to our atmosphere there would have been a glare of light in front, which would more or less have illuminated the body of the moon. Mr. Proctor illustrated his arguments further by means of a diagram of the moon's shadow falling on the earth and its atmosphere, which he explained, and said that if we applied the test of observation to this reasoning it would be found correct. The prominences and chromosphere might illuminate the edge of the disc, but if the glare were in our atmosphere it would affect it all over. In an annular eclipse the observer ought to see a black disc with light all round lasting only the few seconds of annularity, and it will be found that this has been noticed. In a total eclipse the edge of the moon should be found somewhat brighter, and Mr. Baily has recorded such an observation. If the corona of a solar eclipse be terrestrial, it ought to be seen in partial eclipses, and before and after totality. Capt. Noble's paper to-night shows that there must be a light background beyond Venus for the planet to be seen as a dark body. What is the corona, if it be not in our atmosphere? It has been suggested that it is the thick richer part of the zodiacal light. The author inclined to this view, and was sorry to hear Capt. Noble's observation that the light was not in the line of the ecliptic, but it certainly, as a rule, follows that direction, and especially where it is best seen. There may be reasons for supposing that this is a ring at some distance from the sun, but

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the appearance is not accordant with Mr. Balfour Stewart's electrical theory. Were this correct, it would not rise and set. We have looked too much at the physical characters and neglected the mathematical objections. It would change position with the latitude. In fact it cannot be near the earth, and must be at least as far as the moon. In the tropics the zodiacal light increases in brightness as it approaches the sun's place, and if we could trace it up to the sun, it would be at least as bright as the corona. Le Verrier's ring of bodies within the orbit of Mercury would account for some of its perturbations. Mr. Baxendell thinks meteoric phenomena and weather changes require some such view. As long as the meteors were supposed to be a ring at about the earth's distance there was no difficulty, but now we know their orbits are very eccentric. There are 56 systems of them, and they must be millions of millions in number, and it may be possible that some may yet be seen during eclipses. The paper concluded with suggestions for observations at the next total solar eclipse, in order to ascertain what the corona really is, and also proposed the appointment of a committee to consider the course to be taken on that occasion.

Capt. Noble: My paper was not written to support any theory whatever, but to state that, while the books tell us the zodiacal light follows the course of the ecliptic, on this occasion it formed an angle of 20° with that line.

The President: At Malta the light is seen the same as here, but brighter. It is two or three times as light as the brightest part of the Milky Way, and at once fixes the attention. It is visible in spring and autumn, but best in February. I cannot say I have noticed a positive shadow cast by it, but it is very bright. It gives a perceptible light to the earth, and generally follows the path of the sun. It includes Aries and the Pleiades, and sets with them.

Capt. Noble: On the night of my observation it was noticeably brighter than the Milky Way in Cygnus.

Mr. Proctor: According to my idea, that it is the richer part of the meteor system in the neighbourhood of the sun, and probably extending as far as Mars, it need not be consistently bright. I have dealt with the spectroscope observations of the corona, which are not exact enough at present. The meteors ought to be incandescent, so that there would be reflected light and incandescence, giving a mixed spectrum—a continuous one, and bright lines. Its polarisation would also have to be examined.

Mr. Lassell: I don't think the zodiacal light has ever been seen at a total eclipse.

Mr. Proctor: Probably, if the observer would keep his eyes in darkness for some time previously, he might see it.

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Dr. Mann enquired whether the President, when observing at Malta, had noticed the suddenness with which the light loomed up? He had seen this happen twenty times in the tropics.

The President: Malta is 35° North. I have not noticed the fact; but in the tropics the light is much stronger.

Mr. Browning handed round a recent drawing of Venus, and stated that, without any special contrivance, he could see the globe of the planet.

Capt. Noble pointed out the difference in aperture between his 4·2-inch Achromatic and Mr. Browning's 12-inch reflector.

Mr. Chambers enquired whether the Government proposed to assist astronomers in going out to Spain to observe the eclipse of December next?

The President: The Government does not *propose* to do anything of the kind; but the Council is preparing to lay before them a statement of the required observations, and to urge the necessity of some assistance.

Mr. Stone: If gentlemen be sent to observe polarisation, I hope there will be three at least, as two might contradict one another. The recent accounts from America make this a most puzzling question. In India, all agreed the corona was polarised in a plane passing through the centre of the sun; but the American observers say it has nothing to do with the centre of the sun. I hope this will be made a special subject of study. Several parts of the corona ought to be examined. Perhaps in India they did not go entirely round. A sufficient part of the corona should be tested, so as to be sure the plane passes through the centre of the sun.

A Gentleman enquired whether any connection had been established between the zodiacal light and the retardation of Encke's Comet?

Mr. Stone: It has been suggested, but not established.

The meeting then adjourned.

PARIS OBSERVATORY.—M. Delaunay has been appointed Director of the Paris Observatory in place of M. Le Verrier, and not M. Faye, as at first reported.

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CORRESPONDENCE.

N.B.—We do not hold ourselves answerable for any opinions expressed by our correspondents.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

D'ARREST'S COMET.

Sir,—The following ephemeris of this body for the month of April will be useful to some of your readers:—

Berlin Mean Moon.

1870.	R.A. h. m. s.	N.P.D. ° ′
April 1	16 13 12	88 1
3	16 13 59	87 39
5	16 14 40	87 17
7	16 15 15	86 54
9	16 15 44	86 30
11	16 16 7	86 5
13	16 16 23	85 41
15	16 16 32	85 16
17	16 16 35	84 50
19	16 16 31	84 24
21	16 16 20	83 58
23	16 16 2	83 31
25	16 15 36	83 5
27	16 15 3	82 38
29	16 14 23	82 12

I remain, your obedient servant,

Windyhills Observatory, Bickley: G. F. CHAMBERS.
March 7, 1870.

REFLECTING TELESCOPES.

Sir,—I shall feel grateful for some really reliable information upon the following point:—

Does the separating power of a telescope depend upon its aperture only? or upon its aperture and focal length combined?

In order to reduce the matter to its simplest form, I will confine my question to Newtonian reflectors of perfect parabolic curvature and perfectly mounted. Starting with a 10-in. mirror, 7 ft. 6 in. focus, I suppose that in separating power this would be surpassed by a 12-in. mirror of the same focal length, and also by a 12-in. mirror of the same proportionate focal length, 9 ft. Now, taking a series of 12-in. mirrors, whose focal lengths gradually increase from 9 ft. to 20 ft., will all of these be superior in separating power to the 10-in. mentioned above? Or, if not, at what stage in the series will the superiority of the larger aperture be neutralised by the greater proportionate focal length?

I remain, Sir, faithfully yours,

Aberdeen, March 1870. ARTHUR W. BLACKLOCK.

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SPECTROSCOPE CONSTRUCTION.

Sir,—May I enquire, through the pages of the *Register*, whether one of your numerous array of talented correspondents would kindly contribute an article on "Spectroscope Construction"? I mean an article containing a few practical directions such as would enable an amateur like myself, by the purchase of suitable prisms, and the exercise of a little ingenuity, to construct a simple spectroscope suitable for a telescope of, say, from two to three inches aperture.

In a well-known weekly journal, which devotes some space to practical astronomy, I have noticed that this question has been asked very frequently without eliciting any reply; therefore I think that such a subject as is now enquired for would possess some general interest.

I am, Sir, yours truly,

Dalston, March 10, 1870. W. P.

TELESCOPE PERFORMANCE.

Sir,—As many of your correspondents take an interest in comparing the performance of their telescopes with others of a similar aperture, and as I believe there are many of the same aperture as my own, viz. 4½ inches, spread throughout the country, and by various excellent makers, I send you a list of a few test objects well seen during the last two or three months.

ε Arietis clearly divided with a moderate power. η Orionis divided with high powers; a very slight appearance of flattening of the disc of the smaller and dull-coloured star with a power of 350. This star appears the utmost limit of the dividing power of my instrument. I have a Huyghenian eye-piece by Dallmeyer, which gives a power of at least 520 or 530, and with this power star discs are beautifully defined in good air. This o. g. will also elongate, although only slightly, γ^2 Andromedæ and ζ Cancri. As to tests of illuminating power, on four or five occasions I have seen, during the last two months, the 6th star in the Trapezium, once beautifully steadily, best power 225. The fifth is generally visible. The faint companion of λ Orionis I see steadily with all powers, more difficult with the lower ones. 15 Monocerotis I see quadruple. On three or four occasions I have seen steadily the 15th mag. star companion of the double 52 Arietis at 5″—best power 150; this small star is a beautiful test object. All these objects have been seen steadily, not as glimpse stars, but by direct vision. I see 15 stars in the group ο Orionis, that is to say, if the apparently uppermost or really southern star σ is considered as one of the group. One or two of these, although really seen, are only to be brought out by averted vision and high powers. The little 11th mag. star, in this group, is not put out, as it were, with 450; and I have also seen the companion of α Lyræ with a very high power. I have seen six spots on the floor of Plato, and I dare-say I could make out more under very favourable circumstances. Jupiter will not often stand a power higher than 225; the outline of the disc is sharp with 500; but there is not sufficient illuminating power to bring out the belts with a high power. Venus, on the contrary, will bear a considerable amount of magnifying power, if at a good altitude, and in a moderately dark sky. I have seen this planet, lately, really well defined with an achromatic eye-piece, magnifying on my telescope nearly 500 times. I like the performance of these microscopic eye-pieces on planets, even with the refractor, better than any others. I have been used to much larger aper-

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tures, both reflectors and refractors, but for its small size this is the best instrument I ever saw. The glass is the manufacture of Messrs. Chance of Birmingham, and is evidently of the finest quality, without which, however perfect may be the skill of the optician, the result of his labour can never be satisfactory. I have had an opportunity of testing the dividing powers of a good many instruments, both reflectors and refractors, and as far as my experience goes, dividing power of telescopes does not depend alone on aperture, irrespective of focal length and of figure.

I am, Sir, yours truly,

Yarmouth: March 1870. W. MATTHEWS.

THE HACKNEY SCIENTIFIC ASSOCIATION.

Sir,—You will be pleased to learn that the "Hackney Scientific Association," whose opening conversazione you very kindly noticed a few months back, is progressing very satisfactorily. The number of members (although still small) is nearly twice as many as in the previous session; while the papers read have been of considerable interest and importance, a great proportion of the subjects having been astronomical.

The titles of those read already are as follows:—

1. Comparative psychology.
2. The nebular hypothesis of La Place in the light of modern discovery.
3. The local origin of disturbances affecting the Earth's surface.
4. The markings on the planet Jupiter.
5. Tyndall's cometary theory.
6. The planetary origin of weather changes, with the probable weather for 1870.
7. Recent researches into organic dust.

Reports of these (often very full) appear in the various local journals, and thus contribute, we hope, to the spread of scientific knowledge.

No. 4 appeared in full in *The Mechanic* for Feb. 5, 1870, and I take the liberty of enclosing a local report of No. 6, which, bearing upon the *weather*, may possess some interest to astronomers. Of course the report does not give Mr. Pratt's method of calculation, but past experience assures us of the correctness of his results.

We are endeavouring to form a small *Library* of scientific works for the use of members; for without a library we find it difficult to obtain any large acquisition of members, and being without any *funds* to speak of, we find the task progresses very slowly. If any of your numerous readers had any old books, upon astronomy or other sciences, to spare, we should receive them gladly.

Perhaps you would kindly mention this latter fact in the corner of the *Register*.

I remain, yours truly,

Meeting Rooms: H. W. EMONS,
26 Fleming Street, Kingsland Road. *Hon. Sec.*

THE SUPPOSED PLANET VULCAN.

Sir,—Another systematic series of observations of the sun are about to be commenced, with the object of re-discovering the suspected new planet Vulcan in transit. There will be about twenty-five gentlemen engaged in the affair, each of whom has a certain fixed time every day during which to

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carefully examine the solar disc. The observations will extend over the period from March 20 to April 10, and there is every reason to suppose that the search will end satisfactorily, if not successfully. The fact of the time of maximum frequency of the solar spots having arrived will give additional interest to the observations. The list of those engaged in the search includes the names of Messrs. W. R. Birt, F.R.A.S.; G. J. Walker; T. G. E. Elger; E. B. Knobel; J. Birmingham; T. P. Barkas; James Cook; Henry Pratt; Jno. Watson, F.R.A.S.; T. W. Backhouse; H. W. Hollis, F.R.A.S.; T. Wilson; P. Vallance; A. P. Holden; H. Ormesher; and others.

When the observations have terminated, I will send you a particular account of the results obtained.

I am, dear Sir, truly yours,

Bristol: March 1870. WILLIAM F. DENNING, Hon. Sec. O.A.S.

NOTES ON THE WONDERS AND BEAUTIES OF THE STARRY HEAVENS.

Sir,—I regret to see that the numerous contractions in my MSS. of observations on Cassiopeia have been a source of difficulty, and the cause of several errors. The sole object of the abbreviations was the fear of extending what was already a rather lengthy article. I therefore take the present opportunity to correct, and at the same time to add a few notes as a postscript to my paper.

(ϵ). The colour of this star is greenish, not Greenwich, as printed. The last clause of this paragraph should read,—$\frac{3}{4}^{\circ}$ north of this is 52, a creamy star, with a faint distant companion south following. $\frac{1}{2}^{\circ}$ preceding this is a little cluster, containing two open pairs.

The notices of η and ι are printed together, instead of being in two separate paragraphs as intended. After saying of η,—"I find the colours distinct, yellowish and purple, a fine pair with 220"—the notice of this star is concluded. Then should follow, as a separate paragraph, the notice of ι, or P. II. 72; meaning, of course, star No. 72, in the second hour of right ascension of Piazzi's catalogue.

(κ). I may be allowed to call attention here to the singular arrangement of the stars adjacent to this object, as well worthy of further consideration. It can scarcely be supposed that two sets of three nearly equal stars should be so located in space that their lines of direction should lie nearly at right angles to each other, and at the same time should intersect at this star, simply as the result of accident. Moreover, this is not a solitary case; there are numerous instances of singular proximity and curious arrangement among the stellar host which the researches of modern astronomers have shown to be the result of real physical connection; and we have good reason for believing that such connections exist in the sidereal heavens in a much greater number of instances than is generally supposed.

(λ). Under the notice of this star, the position of a wide pair of stars of 8, 9 magnitude is given as 300″ instead of 300°.

I take the present opportunity of informing my kind correspondents that, since completing these observations, circumstances have occurred which have rendered it desirable that I should remove to London. I beg, therefore, to append my address, and shall be happy to receive any communications relating to observational astronomy.

1 Braywick Cottages, I am, Sir, truly yours,

Prescott Place, Clapham. C. GROVER.

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THE MOON'S MOTION.

Sir,—In the supplementary number of the *Astronomical Register* of 1869, I observe a letter from Mr. Elvins on the motion and physical constitution of the moon. Mr. Elvins certainly deserves the thanks of all who, like himself, deny the axial rotation of the moon, inasmuch as he has had the courage to propound a theory to account for the phenomena of *libration*, which fatal objection to their theory has always hitherto been prudently ignored by the non-rotationists in the many letters which from time to time have appeared on this subject in the pages of the *Register*, although they have been frequently challenged on this point.

Mr. Elvins tells us that he was formerly a believer in the moon's rotation, but that he has since changed his opinion—he does not say by what argument he was convinced—but that which he has made use of in his letter, in order to convince others, is assuredly an erroneous one, since it rests upon an undue assumption; and exactly the same may be said of the illustration relied on by Mr. Perigal in the *Register* of March 1869, of which Mr. Elvins so highly approves. Both these gentlemen forget that the moon is not rigidly connected with the earth by a bar of iron or any material bond, but by a force, invisible and intangible, which, according to universal consent, is simply defined as "varying directly as the mass attracted, and inversely as the square of the distance of the latter from the centre of force." If to this Mr. Elvins adds that it possesses likewise the singular property of causing the body attracted to keep always the same face turned towards the centre of attraction, he is seriously tampering with the law of gravitation, which with this addition becomes quite another thing from that discovered by Newton; and, in that case, the whole of modern astronomy would need to be recast.

Astronomical innovators, I fear, are rather apt to indulge some favourite theory on very slight grounds, and without due regard to its consequences or agreement with facts. Let Mr. Elvins ascertain by direct experiment whether, when one body revolves *freely* around another, i.e. not rigidly connected with it, under the influence of gravity, it does, or does not, turn always the same face towards the attracting centre. This may easily be tried, and would set this part of the dispute at rest for ever. Let me refer him to a letter, signed "P." on page 170 of vol. ii. of the *Register*: which letter up to the present time has not been answered.

Mr. Elvins, moreover, has based his theory of libration upon the assumption of facts which do not exist. What is called libration is not an *actual motion* of the moon, but an *apparent motion*, to be accounted for simply and readily on the received theory of astronomers, that the moon's rotation is equable in speed while its revolution is variable; but not to be accounted for on any other supposition. Were Mr. Elvins's theory correct, there would be a corresponding libration of the shadow terminator, which has never been observed to exist.

I am, Sir, yours faithfully,

March 3, 1870. ALFRED W. DEEY.

Hartley Rectory, Alton, Hants.

P.S.—I may add that Mr. Elvins, in his letter in reply to Mr. Dawson, p. 173, vol. vii. of the *Register*, has in like manner argued erroneously in his endeavour to show that the outer or more distant part of a revolving body must necessarily move faster than the inner (i.e. the nearer to the centre of force). This, to be true, assumes that a body revolving around another under the influence of gravity, and not rigidly connected with it,

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must of necessity turn the same face always towards the centre of attraction; which, as I have said above, necessitates a new definition of the law of gravitation, and is, I maintain, contrary to fact.

Sir,—Will any of your subscribers, who insist that the moon turns on her axis, define any conditions whatever, that they can imagine or describe, under which, according to their views, and presuming that her orbital motion round the earth, and the earth's round the sun, remained unaltered, she would not turn on her axis?

Yours obediently,

March 11, 1870. AMATEUR.

FARADAY ON OPTICAL GLASS.—In 1829 Faraday gave the Bakerian Lecture at the Royal Society, on the Manufacture of Glass for Optical Purposes. This most laborious investigation did not end in the desired improvement in telescopes; but the glass thus manufactured became of the utmost importance in his dia-magnetic and magneto-optical researches. He says, "When the philosopher desires to apply glass in the construction of perfect instruments, and especially the achromatic telescope, its manufacture is found liable to imperfections so important and so difficult to avoid, that science is frequently stopped in her progress by them —a fact fully proved by the circumstance that Mr. Dollond, one of our first opticians, has not been able to obtain a disc of flint glass 4½ inches in diameter, fit for a telescope, within the last five years; or a similar disc, of 5 inches, within the last ten years. This led to the appointment, by Sir H. Davy, of the Royal Society Committee, and the Government removed the Excise restrictions, and undertook to bear all the expenses, so long as the investigation offered a reasonable hope of success. The experiments were begun at the Falcon Glass Works, three miles from the Royal Institution, and continued there in 1825, 1826, and to September 1827, when a room was built at the Institution. At first the enquiry was pursued principally as related to flint and ground glass; but in September 1828 it was directed exclusively to the preparation and perfection of peculiar heavy and fusible glasses, from which time continued progress has been made." The paper then proceeds with an exact description of this heavy optical glass: "its great use being to give efficient instructions to the few who may desire to manufacture optical glass." In 1830 the experiments on glass-making were stopped. In 1831 the Committee for the Improvement of Glass for Optical Purposes reported to the Royal Society Council that "the telescope made with Mr. Faraday's glass has been examined by Captain Kater and Mr. Pond. It bears as great a power as can reasonably be expected, and is very achromatic. The Committee therefore recommend that Mr. Faraday be requested to make a perfect piece of glass of the largest size that his present apparatus will admit, and also to teach some person to manufacture the glass for general sale." Faraday declined to continue the investigation at the time; and in 1845 he says: "I consider our results as negative, except as regards any good that may have resulted from my heavy glass in the hands of Amici (who applied it to microscopes), and in my late experiments on light."—*Life of Faraday*, by Bence Jones, Vol. I.

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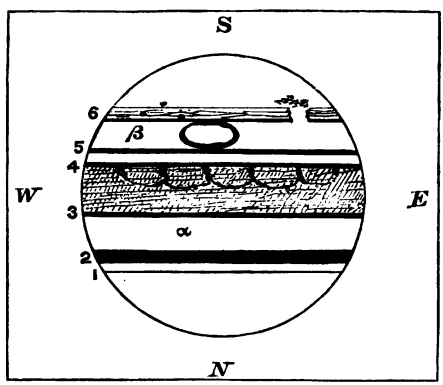
PHYSICAL OBSERVATIONS OF JUPITER,

FROM NOV. 4 TO DEC. 31, 1869.

The observations, of which the following is a condensed account, were made at the Observatory of Edward Crossley, Esq., F.R.A.S., Park Road, Halifax. The instrument chiefly used was the large equatorial, 9½ inches aperture, by Cooke & Sons. Generally, the full aperture was used. The highest power, which was not applied more than twice, was 470. The usual working power was 240.

The planet was first examined on July 9–14, but owing to press of other work, and the late meridian passage, systematic and careful delineation and observation were postponed until October. On comparing the notes and sketches made in August with those of November, December, and January 1870, it was found that the principal features had been detected in the earlier months. To avoid unnecessary detail and repetition, however, the observations of November and December 1869 have been chosen to illustrate the remarkable and interesting appearances on the disc of this fine planet. It may perhaps be well, at the outset, to specify and describe the most striking objects seen on the disc, and also to give a reference diagram of the dark bands which have been so conspicuous even in small instruments.



1. The dark equatorial zone was always a most striking feature; but it was seldom that this difficult part of the disc could be really well seen. In October, November, and December, as well as in August and September, whenever the air was good, the ruddy tinge was easily seen. The dark loops or ellipses attached to the southern bounding band of this zone put on various appearances, according to the definition. Sometimes, as on October 27–8, they appeared as detached, black, oblong spots, eight in number, with bright spaces between them; while, on November 4, at 13h., the bright spaces were more prominent than the dark spots. At other times, as on Nov. 28, 12h., they assumed the form of large ellipses, six or eight in number, lying end to end, the width of the ellipses being half that of the zone in which they lay. Lastly, the dark zone seemed to be crossed by dark narrow bands, as if the ellipses had been broken and stretched out to the north.

2. *The great southern ellipse.*—This fine object was easily seen every fine night. It was first distinctly seen at 11h., November 14, and was then in the middle of its path across the disc. It lay between bands 5 and 6, touching 6, but not quite in contact with 5. Its length was about one-third that of band 6; its east end was the darkest part of it, and also the broadest; in other parts it was a fine narrow sharp dark line. The space

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within it was bright, but not brighter than that of the zone in which it lay. No spots or marks could ever be detected within it, nor could any change in size or shape be discovered.

3. *The break in the south band.*—To the south of the double band, bounding the dark equatorial region, is a broad dusky band with parallel edges. In this band have been seen, every fine night, bright spots, and a gap or break. The spots were large bright circular objects, very closely resembling a satellite on the disc. On November 30, at 9h., after a close scrutiny, Mr. Crossley thought the spots appeared slightly oval, and not sharply defined at their edges. They were of different sizes, were always rather difficult objects, but some, from their fixed position, could be identified night after night.

The gap or break in 6 was first noticed at 11h. October 6. It appeared as if a small portion of the band had been cut out and laid on the top; but the exact form of the object thus apparently placed on the south end of the gap could never be very accurately made out. In December, close to the west of this object, and lying upon band 6, there appeared a dusky patch of no very definite shape.

All these features are represented in the diagram. After a few nights' watching it was observed that the southern ellipse, the ellipses under band 4, and certain changes in appearance of other features followed each other in a fixed order. The changes in appearance of other features were these:—First, band 5 was sometimes quite invisible, sometimes faint, and sometimes as broad and dark as band 4; second, when band 5 was first seen to come on the disc, it was always attached to band 4 by a long sloping arm; third, band 6 was sometimes very broad, at others narrower and fainter, and then again it was irregular and shaded off to the duskiness of the south polar region; fourth, band 1 was broken, and also seemed to be darker and broader at one time than another. This last object, however, was always rather difficult, so that it was not well observed as to the periods of its changes. Fifth, a break was also observed in band 2; sixth, band 3 was several times suspected of considerable changes in breadth and depth of tint.

The observed order of these appearances was this:—When the break or gap in 6 appeared at the east edge of the disc, 6 was a fine, broad, parallel-sided dusky band; 5 was broad and dark nearly up to its east extremity, spots were seen on 6, and dark objects under 4. As the gap in 6 approached the centre, 5 became invisible, 1 very faint, and a spot or two appeared close to the west of it.

After an interval the southern ellipse appears on the east, 5 is invisible, 6 is very broad, and as the ellipse advances, 6 tapers off to the dusky polar shading. But just under the central point of the ellipse, 5 is seen touching 4, and gives a wedge-shaped form to the two when seen near the east edge of the disc. Band 5 becomes broader and darker, the ellipse passes the centre, and 6 now appears a little to the east of it as a narrow faint band. Under the ellipse, and attached to the southern bounding band of the equatorial zone, are now seen fine large ellipses, the two central ones appearing like great staring eyes. Fine bright spots are at this time often seen to the west of the ellipse, and lying within band 6.

4. *The bands, or dark streaks.*—Of these, No. 2 was always the broadest and darkest, and seemed much the same throughout a complete revolution. No. 1 was the narrowest, and, for the most part, the faintest. Some parts are much darker and slightly broader than others. No. 3 is subject to changes in width and tint; it is not usually so broad and dark as No. 4. Band 6 differs from all the others in having its upper and lower edges perfectly parallel and sharp, and its surface of uniform dusky tint.

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5. *The Zones.*—The equatorial zone is always the darkest, α is the brightest. β is a little less bright than α. The narrow polar bands were not studied; but those in the north appeared slightly darker than the southern.

JOSEPH GLEDHILL, F.G.S., &c.

Park Road Observatory, Halifax.

(*To be continued.*)

THE SATELLITES OF URANUS.

From an Ephemeris of the Satellites of Uranus, by A. Marth, Esq., printed for the Royal Astronomical Society, we extract the following:—

Angles of Position at 8h. Greenwich Mean Time.

1870	Ariel.	Umbriel.	Titania.	Oberon.
	°	°	°	°
April 1	271	19	11	120
2	132	302	336	90
3	345	205	297	58
4	196	128	249	29
5	53	31	204	5
6	278	314	169	343
7	137	217	132	320
8	350	141	86	293

The Apparent Distances vary between the Limits.

		"		"
Ariel	...	15	and	12
Umbriel	...	21	...	16
Titania	...	35	...	27
Oberon	...	46	...	36

The above may be of use to those of our subscribers who are in possession of powerful telescopes.

LUNAR MAP AND CATALOGUE.

Mr. Birt has issued a report of progress of the Lunar Map and Catalogue during the past year, with a statement of receipts and expenditure; also a list of subscribers and donors. From the Balance-Sheet it appears that, after paying all expenses, including the production of the monogram of the Mare Serenitatis, there are sufficient funds in hand to proceed with the fourth area of the Map, which we find is now in the printer's hands, and it is intended forthwith to map the fifth area IVAγ of Zone II. Mr. Birt promises a monogram of "Hipparchus," which is not exhibited in its individual aspect on either of the four completed areas of the Map. It will form a portion of the issue to subscribers for the second year. The report alludes to the work that has been effected with regard to the spots on Plato; the number of observations received from subscribers being over 700. The results of these observations are to be given in "Lunar Map Circular VIII."

The Map of the Mare Serenitatis which we published in February 1869 is noticed as having been carefully examined, and we find that our correspondents Messrs. Joynson and Williams are engaged in specially re-observing the objects that Mr. Birt has been unable to identify, amounting to 144. Schmidt's Lunar Map is mentioned as being completed.

A very important paragraph in the report draws attention to the number of objects on the moon's surface registered *but not printed*, and speaks of the desirability of some steps being taken for printing the

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catalogue, as, should the only existing record of it be destroyed, the loss will be considerable, if not irreparable.

The report, which enters into the progress of Selenography generally, appears to be satisfactory, and we doubt not that with increased subscriptions a larger amount of work would be effected.

OBSERVING ASTRONOMICAL SOCIETY.

Report of Observations made from January 7 to February 6, 1870, inclusive.

Sir,—The following observations by Mr. H. Ormesher, of Manchester, arrived too late for insertion in the last report:—

The Aurora Borealis of January 3rd.

"My attention was directed to a luminous belt of light about 5° in breadth, which stretched across the heavens from a point of the horizon E.N.E. passing close by the stars Castor and Pollux, from thence to the Pleiades, and on to a point in the opposite horizon W. by N. This belt increased in intensity until 7h. 10m., when it became split, as it were, into two different rings. At this moment luminous streams of light shot forth from the northern part of the horizon upwards to beyond the zenith of my place of observation. These streams of light were quite of a rosy hue, and changed their position every few seconds. At about 7h. 30m. they became of quite a ruddy hue. At 8h. 15m. the sky became overcast, and remained so until 9h. 30m.; at this time I observed again, but all traces of the Aurora Borealis had passed away."

Venus.

"I have made two day observations of this planet, and you may depend upon them, as they were made under very favourable circumstances.—1869. Dec. 19, 3h. 43m.—I observed three dusky spots on the disc of the planet. The irregularities of the form of the terminator distinctly seen. The S. cusp appeared very blunted, while the N. one was sharp, with a large indentation near it. Dec. 25.—Observed Venus at transit, at 3h. 26m. 45s., and saw four dusky spots on her surface. As on the 19th, the irregular outline of the terminator was very apparent. The N. cusp was slightly blunted, the S. one not so."

Venus.

Mr. H. Michell Whitley, of Penarth, Truro, writes that "This planet was observed to cast a very distinct shadow on January 26. Every twig of the trees through which she was shining was sharply projected on a white-washed wall."

Jupiter.

Mr. J. Birmingham, of Tuam, says:—"The most remarkable feature I can notice is a branch S. equatorial belt at a very small angle, and seemingly permanent in its position. The space between the equatorial belts is rose-coloured, becoming of a lighter tint towards the centre. Outside the N. equatorial belt I remark a greenish shade as far as the next, which is always the darkest, and seems less subject to change than any of the others. Dark spots and adjoining bright ones are generally visible on the N. edge of the S. equatorial belt. The belt S. of the S. equatorial one seems at times to lie close to the latter, and at other times it is separated from it by a wide, bright space. Frequently it disappears altogether, and in its changes presents a marked contrast to the belt N. of the N. equatorial."

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Mr. H. Michell Whitley, of Penarth, Truro, frequently examined the planet with his 6½-inch silvered reflector, and the following are the results:—

"1870. Jan. 10, 6h.—The equatorial belt of a fine copper colour. The other belts grey. The next belt N. of the copper band very dark and sharply defined. Jan. 22. 6h. to 8h. 30m.—The copper colour of the central belt very fine; along its S. edge lay a dark narrow belt with several faint belts between it and the S. Pole; the N. equatorial belt, as usual, dark, narrow, and well-defined. Jan. 26. 5h. 30m.—Copper belt apparently paler. N. of this belt lay a streak of pale yellow, and below this a narrow, dark band, very sharply defined; beyond this the planet was streaked with grey, growing darker towards the poles. The fading of the belts towards the edge of the disc was very apparent. The shadow of Sat. I. was very black; it traversed the S. edge of the copper belt. There was no visible penumbra round it. Jan. 31. 6h.—The copper tint of the central band seems to be gradually fading. The narrow dark belt on the S. appears to be a little within this band. A number of narrow belts lie between it and the S. Pole. The N. equatorial belt as sharply defined and dark as usual. Feb. 4.—Equatorial copper belt still very conspicuous, with the same dark belt along its S. edge. It is bordered on the N. by a narrow white line which divides it from the copper-tinted belt. This latter appeared, in moments of good definition, mottled with light yellow patches (this mottling of the reddish belt was noticed by Mr. Buckingham at the meeting of the R.A.S. on Jan. 14), giving the idea that the red colour is fading away. The upper equatorial dark belt is irregular in width, and swells out into nodules bordered on the lower edge with lights."

Double Stars.

61 *Ceti.*—Mr. Birmingham says:—"I find a second comes for this star—mag. 12–13, pos. 320°, dis. 60″; all by estimation. As it seems to have been hitherto missed, the Rev. T. W. Webb suggests that it may be variable. I first noticed it with 126 on a 4½-in. aperture, and it greatly improved with 200."

3 *Monocerotis.*—Mr. Birmingham has also discovered a second comes for this star. He says: "I have noted it by estimation—mag. 12, pos. 50°, dis. 60″ to 70″."

"I also find two minute comites to 6 Cancri. In Sigma Orionis the 8 and 7 mag. stars (see Webb) seem to have exchanged magnitudes."

Lunar Observations.

The Crater Linné.—Mr. Birmingham reports that he "saw Linné for the first time on the terminator on Jan. 8. It appeared as a small hill rising up in a very brilliant point from the ravine, while the latter was still in darkness. When the sunlight reached the bottom of the ravine, and a shadow from Linné became perceptible, a shower came on, and continued so long as to prevent any further observation. The sun was not high enough, while I observed the cone, for the detection of any small crater within it. From the position of the hill with regard to the W. ridge of the ravine, and the situation of the 'light cloud' when the hill can no longer be perceived, I am inclined to regard the hill as placed not in the centre of the 'light cloud,' but rather to the W. of it. The W. ridge appeared to divide the ravine in which Linné is situated from another and shallower hollow in which 1Eγ3 and 1Bθ1 are situated. From the base of the latter a low ridge runs in a S.E. direction, to meet the great dividing ridge above-mentioned; and it is crossed by another small ridge which begins in the bottom of the hollow, and ends in a crater close under the great ridge. Traces of

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the boundaries of this ravine are found in Mr. Birt's most useful—and to the observer I should say indispensable—maps of the Mare Serenitatis, but I have seen them far more continuous than he has given them, a complete connection being visible between the ridge ending in the map at 1Eγ3, and the ridge which begins at 1Eι7."

Plato.

"Mr. Birt, in his paper on Plato, says that the central spot No. 1 has been seen as a craterlet. It appears to me simply as a hillock. He says that No. 3, which Mr. Pratt places on the S. edge of the curved streak, is shown by Mr. Knott on the N.E. border. I think I have seen a different object in each situation."

Strange Formation W. of Fontenelle.

"This extraordinary object, which, as B. and M. say, must 'throw the observer into the highest astonishment,' and which Webb complains he looked for repeatedly in vain, was seen to great perfection on Jan. 10. I believe it to be the extant remains of several craters, where the greater portions of the circles are no longer discernible, and several short segments linked together form lines of more or less regularity. This may be recognised on the N.E. side, while it is very evident on the W.; and the explanation may, I imagine, be applied to many of the rectangular figures on the moon's surface. The S.E. rampart is the most regular, and, with the rather sinuous N.E. embankment, forms the sharpest angle of the figure next to Fontenelle. The S.W. rampart is regular enough, and so is, at a low elevation, the N.W. boundary; but on the W. is a re-entering angle pushed in from an adjoining formation of the same character as the other. This second formation extends to the S. in two cape-like prominences, and to the N. in two broad and shallow confluent craters. Taken together, they certainly form one of the most striking scenes on the lunar surface."

I am, Sir, truly yours,

WILLIAM F. DENNING, Hon. Sec.

Ashley Road, Bristol:
Feb. 16, 1870.

Private Observatories.—Can you not collect and publish the positions of the private observatories in this country, saying whose they are, and how the results were obtained? It would render available the observations you sometimes print, and would be otherwise interesting and useful. The old enquiry you made about the instruments seems to have come to nothing, but it, too, might be included.—T. G. R.

[We shall be very glad to fall in with this suggestion, and will look up the papers formerly received. Those subscribers who did not send us the former returns, or who have joined us later, might assist us by a single line at their convenience, thus:—

Name.	Place.	Latitude.	Longitude.
Description of telescope; aperture and focal length.		Transit instrument.	Clock.

Mira Ceti.—Guillemin's "The Heavens," p. 359, says that the irregularities in the period of Mira are subjected to a periodicity. Can you inform me what this periodicity is? T. W. B.

Dialyte Telescope.—The owner of a "Dialyte" would confer a favour on your readers, including myself, by giving information as to the

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curves, foci, and distances of the lenses, the expense and performance compared with the regular refractor, and his view of the advantages of this construction. T. H. B.

[In a letter dated February 23, H. I. writes: "I am rather interested in this construction (the *dialyte*), and would like to see it more noticed. My former dialyte of 4½ inches would show a black division to 36 Andromedæ. With my present 5½-inch object-glass, corrected by the same plan (in fact with the same corrections used for the 4½-inch one, the flint glass of which is very dense), 36 Andromedæ is very easy, as also 170 P. VII., which is divided by a space equal to about one disc of B; and on some occasions when the air was very fine I was astonished to find that I could divide Bird's close double, 9½ magnitude, following Procyon, whose distance Dawes estimated at 0″·6; of course it was very difficult, but there was no mistake about the separation. The larger the star, the more difficult to divide; I should think the dividing power of my dialyte for 6th magnitude stars would be about 0″·9; for 8th magnitude, about 0″·8."]

THE PLANETS FOR APRIL.

AT TRANSIT OVER THE MERIDIAN OF GREENWICH.

Planets	Date	Right Ascension	Declination	Diameter	Meridian Passage
		h m s	° ′		h m
Mercury	3rd	0 21 18	+ 0 17½	5″·0	23 31·0
	19th	2 13 44	13 47½	5″·2	0 24·1
Venus	3rd	22 15 49	− 7 22½	36″·2	21 25·8
	19th	23 2 53	5 14	28″·6	21 9·9
Saturn	3rd	17 53 40	−22 10½	15″·5	17 4·4
	19th	17 53 8	22 10	15″·9	16 1·0
Uranus	3rd	7 18 9	+22 43½	4″·0	6 30·6
	19th	7 19 9	22 41	4″·0	5 28·7

Mercury crosses the equator on the 3rd of April, and arrives at superior conjunction on the 13th. The distance of the planet from the sun then increases, until at the end of the month the meridian passage takes place about one hour and five minutes after noon. The planet is not well situated for observation during April.

Venus passes the meridian about half-past nine in the morning at the beginning of the month, and earlier each day until the end of April, when its meridian passage takes place about five minutes past nine. The planet is a conspicuous object before sunrise, and well adapted for the transit instrument after nine in the morning, for which purpose we have made use of it in our column of "Meridian passages" this month.

Jupiter is still to be observed, though passing away. **Saturn** is coming into view again, and **Uranus** still tolerably well situated. N.B.—An occultation of Saturn takes place shortly before 3 o'clock on the morning of the 20th.

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ASTRONOMICAL OCCURRENCES FOR APRIL 1870.

DATE		Principal Occurrences		Jupiter's Satellites		Meridian Passage
		h. m.			h. m. s.	h. m. Venus. A.M.
Fri	1		Sidereal Time at Mean Noon, 0 38 34·3	1st Tr. I. „ Sh. I.	9 7 9 59	9 30·6
Sat	2		Meridian passage of the Sun, 3m. 38s. after Mean Noon	1st Ec. R.	9 29 52	9 29·0
Sun	3	22 49	Conjunction of Moon and Jupiter, 3° 53′ N.	1st Sh. E.	6 41	9 27·4
Mon	4			3rd Ec. R.	7 19 59	9 25·8
Tues	5			2nd Sh. I. „ Tr. E. „ Sh. E.	7 30 8 20 9 55	9 24·4
Wed	6					Moon 4 9·2
Thur	7	14 44	Conjunction of Mars and Mercury, 0° 50′ S.			4 59·1
Fri	8	13 47 13 59 14 38 16 25 20 2	Occultation of 56 Geminorum (5½) Reappearance of ditto Conjunction of Moon and Uranus, 1° 1′ N. ☽ Moon's First Quarter Conjunction of Neptune with the Sun			5 51·1
Sat	9			1st Oc. D.	8 30	6 44·5
Sun	10			1st Tr. E. „ Sh. E.	7 52 8 36	7 38·8
Mon	11	14 15 15 4	Occultation of 34 Leonis (6) Reappearance of ditto	3rd Oc. R. „ Ec. D.	8 42 9 29 26	8 33·3
Tues	12			2nd Tr. I.	8 42	9 27·6
Wed	13	4 18 12 48 13 2	Superior conjunction of Mercury Occultation of *b* Virginis (6) Reappearance of ditto			10 21·8
Thur	14		Illuminated portion of disk of Venus = 0·379 of Mars = 0·998			11 16·1
Fri	15	10 26	○ Full Moon.			12 11·1

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DATE		Principal Occurrences		Jupiter's Satellites		Meridian Passage
		h. m.			h. m. s.	h. m. Venus. A.M.
Sat	16		Sidereal Time at Mean Noon, 1 37 42·6			9 12·7
Sun	17	12 16 13 6	Saturn's Ring: Major Axis = 39″·39 Minor Axis = 17″·50 Occultation of θ Libræ (4½) Reappearance of ditto	1st Tr. I. „ Sh. I.	7 40 8 18	9 11·9
Mon	18		Meridian Passage of the Sun, om. 43s. before Mean Noon	1st Ec. R.	7 49 15	9 11·2
Tues	19	14 55 16 5 15 40	Occultation of Saturn Reappearance of ditto Conjunction of Moon and Saturn, 0° 49′ S.			9 10·5
Wed	20	13 6	Occultation, reappearance of ν^2 Sagittarii (5)			9 9·9
Thur	21			2nd Ec. R.	9 15 33	9 9·3
Fri	22	4 25	☾ Moon's Last Quarter			9 8·7
Sat	23					9 8·2
Sun	24					9 7·7
Mon	25	21 53	Conjunction of Moon and Venus, 4° 36′ N.			9 7·2
Tues	26					9 6·7
Wed	27					9 6·3
Thur	28			2nd Oc. D.	8 34	9 5·9
Fri	29	4 10	Conjunction of Moon and Mars, 4° 48′ N.	3rd Sh. I. „ Tr. E.	7 26 7 56	9 5·6
Sat	30	6 37 20 42	● New Moon Conjunction of Jupiter and Mercury, 2° 54′ N.			9 5·2
Sun May	1	17 31 20 28	Conjunction of Moon and Jupiter, 3° 30′ N. Conjunction of Moon and Mercury, 6° 24′ N.			9 4·9

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JUPITER.—Did you notice Jupiter's 3rd satellite on the evening of the 15th February? It appeared to me like a double star in contact, apparently caused by dark markings on the preceding and following sides of its disc. The power I used was a single achromatic lens, giving 386 on my dialyte of 5½-inches aperture.—H. I.

MINOR PLANETS.—In reply to Mr. Holden, none of the other small planets given in the *Naut. Alm.* are well placed for observation in April. The following is the ephemeris for Ceres, for April:—

Days	R.A. h. m.	Decl. ° ′	Merid. Pass. h. m.
1	4 22	22 20 N	3 43
11	4 37½	23 13	3 19
21	4 53½	24 0	2 56
May 1	5 11	24 42	2 34

G. J. W.

THE WINTER STARS.

Sir,—Knowing that to the general public, and, I may say, to no small number of young astronomers, the constellations appear little more than a sort of stellar chaos, at a time of year when their glorious masses are especially brilliant, and never fail to excite the wonder and admiration of even the most ignorant, I have endeavoured to indicate the salient points of these artificial groups, in a series of "Galley Rhymes," which, by calling attention to the quasi-pictorial forms of the constellations, may aid in fixing their general appearance and relative position in the memory; so that, while these rhymes may serve to amuse the more advanced student of the heavens, I trust that they may go a step farther and instruct the numerous class for whom they are particularly intended.

Yours, &c.,
JOHN ANTHONY, M.D. Cantab.

Washwood Heath,
Birmingham.

DESCRIPTION OF A MID-WINTER'S STARRY NIGHT, LOOKING TOWARDS THE SOUTH.

On a mid-winter's starry night
The Milky Way shows full in sight,
Obliquely placed, and seems to rest
Just south-south-east and north-north-west.
In front, on high, the zenith near,
"Capella" shines out fair and clear,
And to her right the "Charioteer";
While, far into the western night,
The Ram (two stars both fairly bright,
With one beneath, made out with ease)
Looks back upon the "Pleiades";
Those "seven fair sisters"—known to all,
A lovely clustered stellar ball.

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More east and south, good vision sees
The V-shaped, "watery" "Hyades"
In the "Bull's head," and there we spy
The glorious star which forms his eye;
That eye, which seems to gaze below,
Which we as "Aldebaran" know.
Beneath the "Bull," in ample space,
In which we few large stars can trace,
Is "Cetus". If a line we try,
From "Pollux", through the "Bull's bright eye",
In the blank space, all but alone,
It finds the star as "Menkar" known.
Now well may the enthusiast warm,
Viewing "Orion's" giant form;
Still "sloping slowly to the west",
With knee upraised, as though he pressed
His curved shield toward the "Bull's broad breast"
And threatening horns. Two stars we may
See close upon the Milky Way,
Which form their tips,—the north one hath
Acquired a name, we call it "Nath":
Take now the giant's frame, and see
His studded belt of brilliants three;
His pendant sword with handle fair,
Oh, what a "nebula" is there!
His broad spread shoulders give to view
"Bellatrix" and bright "Betalgeux";
Slightly above, and eke between,
A triangle of stars is seen,
"Orion's head". Our glance now sent
To where the giant's knee is bent,
On that same foot a gem is shown
Ruddy and bright, as "Rigel" known;
But bright as is this glorious star,
Yet there is one more brilliant far
Which shines south-east—one known to fame
As "Sirius"—the "Dog Star's" name.
Behind "Orion's" bulky form
Is placed the rampant "Unicorn";
And if the giant's starry might
Has climbed to the meridian height,
We see four stars below him there,
The "quadrangle" which marks the "Hare".
This known, we turn our glance away
To eastward of the Milky Way,

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Where "Gemini" and "Leo" shine,
Advancing in the Zodiac line.
Few constellations in the sky
Are better marked than "Gemini";
Each twin symmetrically shines,
Expressed in "two fair stellar lines";
The Royal children, as in play,
Seeming to climb the Milky Way;
"Castor" and "Pollux"—stellar gems,
Marking the Princes' diadems.
One bright star 'neath the Twins is found,
Which Via Lactea seems to bound,
'Tis "Procyon" in the "lesser Hound".
Tracing the great Ecliptic line,
In the south-east is seen to shine
The first of "Leo"—stars which rise
A stellar sickle in the skies;
The handle as recorded thus,
Formed by one bright star, "Regulus":
The sickle's curve, to which we're led,
Half picturing forth the "Lion's head".
'Twixt "Leo's" stars and "Gemini"
But few bright objects meet the eye,
Yet "Cancer's" there,—and steady gaze
Makes out a mass of stellar haze,
As glorious object as can be,
The "Bee-hive cluster"—"Prœsepe".
If now beneath the glance be led,
Three stars shine in the "Hydra's head",
In gentle curve they show to sight,
And conclude our gaze on this winter's night.

ASTRONOMICAL REGISTER—Subscriptions received by the Editor.

To March 1870.
Metcalf, Rev. W. R.

To May 1870.
Linwood, Rev. W.

To June 1870.
Blacklock, A. W.
Buffham, T. M.
Lancaster, J. L.
Lancaster, W. L.
Wright, W. H.

To December 1870.
Bates, T.
Deey, Rev. A.
Knott, G.
Rylands, T. G.
Warriner, H.

March 22, 1870. Subscriptions received after this date in our next.

NOTICES TO CORRESPONDENTS.

The Observing Astronomical Society.—All communications respecting the report of this Society, errata to be corrected, &c., must be addressed to the Secretary, Mr. W. H. Denning, Ashley Road, Bristol.

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THE OBSERVING ASTRONOMICAL SOCIETY.

Hon. Sec. William F. Denning, Ashley Road, Bristol.

Report of Observations made from February 7 to March 6, 1870, inclusive.

Solar Phenomena.

The Rev. F. Howlett reports that on February 15 a very large single spot was visible on the sun's northern hemisphere. It was two minutes of arc in length, "exhibiting a displacement of the solar photosphere to the enormous extent of 1,458,000,000 square miles." Mr. Howlett also refers to his letter, having reference to the spot, in the *Times* of February 23. He says, "I ought to have given the 15th as the day on which I drew and measured the huge spot. . . . It is nevertheless true that there were groups of equally large spots (or very nearly so) on the 11th inst., but I had not time to measure nor describe them."

Mr. George J. Walker states that on February 15 there was "a very conspicuous group of spots on the sun's northern hemisphere. They formed a line about 4¾′ in length. Another smaller group was visible in the S. hemisphere, besides other isolated spots."

Mr. T. W. Backhouse, referring to the large cluster of spots, says:—"During the past month there have been some very fine solar spots, but owing to the very cloudy weather I could not see much of them. The largest penumbra (which was in the N. zone) was about 64,000 miles long on February 15, at 21h. 30m.; on the 16th, at 3h. 45m., it was 60,000 miles long; but on the 16th, at 21h. 20m., it was only 31,000 miles long and 23,000 wide. The preceding spot of the same group had a penumbra 46,000 miles long on the 16th at 3h. 45m. On the 11th, at 21h. 30m., a group in the S. zone contained a penumbra about 54,000 miles long."

Mr. A. P. Holden writes that "the group of spots visible on the 6th presented some remarkable characteristics. One member of a large cluster had in the centre of the umbra a bright white patch, supported by four arms springing from the penumbra; a fifth bridge also crossed the spot further south. Another smaller spot was likewise divided by a number of bright streaks, meeting towards the centre, and appearing, with a low power, like a roughly-made chessboard. One spot (isolated) showed signs of the revolving motion first suspected by Dawes. During my first examination of the solar disc (March 6) I noticed that this spot was crossed by a luminous bridge running from N. to S., but did not notice the shape of the spot itself. As I was at the time engaged in taking a sketch of the spot previously mentioned, I did not further notice the one in question, but on looking at it some 45 minutes after the first sight I was astonished to find that the luminous bridge was in the direction E. to W. across the spot. Whether this was a movement of the whole spot or simply a rapid change in the direction of the bridge it is impossible to say (although the entire spot seemed different to what it was when I first saw it). Unfortunately I was unable to settle this question by further observation, in consequence of the sky becoming rapidly overcast."

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Mr. H. Michell Whitley, of Truro, also observed some very large and interesting solar spots on March 3, at 5h. 30m. There were three large groups visible, consisting of 38 spots. Other spots were "on the disc with extensive tracts of faculæ; solar activity (Wolf's method) = ·82."

The Planet Jupiter.

Mr. J. G. E. Elger, referring to the appearance of the planet during its recent opposition to the sun, says:—"Although no very remarkable changes have been observed in the appearance of the belts since September last, variations have taken place from time to time in their form and colour. The light grey shading surrounding the N. pole of the planet has not varied much. The most noteworthy dark belt (the darkest on the disc) has, since September last, been very persistent and has not changed either in form or hue; the latter was noted as dark blue or indigo, very deep in the middle and fading away gradually towards the limb. The space between this and the N. equatorial belt was the brightest portion of the disc. The N. equatorial belt has varied considerably. On some occasions, notably on January 6, it could scarcely be traced, at other times it consisted of a delicate dark line just sufficient to mark the limit of the ruddy colour of the central bright belt. Great changes were noticed in the intensity of the colour of the space between the equatorial belts: in September and October 1869 it was estimated as equal to *Red* 4 of Smyth's chromatic scale; in December 1869, and in January 1870 (12th and 29th), it appeared to be of a dusky orange hue. White patches (? clouds) were frequently observed on the coloured ground; they were very variable. The northern edge of the S. equatorial belt was generally jagged like a saw, the notches extending some distance into the ruddy space and usually terminating in ill-defined wisps. Another faint belt was seen almost touching the last; it was not always continuous, but sometimes appeared to cease abruptly or to bend upwards towards the S. The shading round the S. pole was much lighter and more variable than that in the neighbourhood of the opposite pole."

Mr. H. M. Whitley writes:—"February 26, 6h. 30m. to 8h. The shading on the edge of the disc very perceptible; the belts fade away into this twilight; equatorial band, copper colour, but not so bright. The belt lying along its upper edge seemed, in moments of good definition, to swell out into round nodules in two places, and at the same time I suspected a white edging to this belt along its lower border, and a streaky aspect of the copper belt. The belt below the equatorial band, very dark and well defined."

Mr. Edmund Salter observed the planet on the evening of January 25:—"Many markings were observed on the belts. It was noticed that the rich dark brown or tawny hue of the central belt was less intense than it appeared recently."

Auroræ Borealis.

The Rev. S. J. Johnson reports:—"There was a display of the Aurora on the night between February 11 and 12, which, but for the brightness of the moon, would have been of surpassing brilliancy. At 11h. 56m. I noticed a vivid red column of light in the W.N.W. stretching three-fourths of the way from the horizon to the zenith. This column was of greater width at the upper end than nearer the horizon. It would be about 10° in width generally; where most brilliant, about 5° more. In five minutes from the time I first noticed it, it vanished. Almost immediately afterwards another streamer sprang up about due north. This one was much

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narrower than the former; reached three-fourths of the way to the zenith, and displayed the red tint again. It was not so bright as the one first visible, though further from the moon. It was slightly curved, and remained in view four minutes. At 12h. 15m. several streamers of the ordinary sort and colour, but bright enough to be conspicuous in the moonlight, made their appearance in the N.N.E. at 1h. 15m. on the morning of the 12th. On the evening of the 21st I noticed the western sky was illuminated by a light about the brightness of the Milky Way. It was ill defined, but of a conical form. The extent of the base was from about α Pegasi into Cetus, and it reached upwards, faintly, beyond the head of Aries. It was 7h. 30m. when I first saw this. Twilight would then have just gone, so I presume it was the *Zodiacal light* I was witnessing. On the evening of the 23rd the Aurora was again visible. A great part of the sky was clouded. The phenomenon was at its best about 8h. 30m. The illumination was considerable; streamers diverged in different directions in the shape of a fan from a point due north. The Aurora contrasted strongly with the broken clouds."

Mr. H. Michell Whitley says:—"February 11, 8h. 30m., an Aurora visible as a low arch of white light, surrounded by a rosy glow in the N.W. horizon. Altitude about 25°."

The Lunar Crater Plato.

The observations of the floor and surroundings of Plato are proceeding with vigour. With one exception, they are conducted by members of the Society. Mr. W. R. Birt has received and discussed as many as 564 observations of the spots, and has projected the greater part in curves. At least double the number of observations, and a further period of 12 months, are needed to form a sufficient basis on which to found an intelligible explanation of the phenomena. By projecting the degrees of visibility in curves, it is found, at present, that the greatest number of spots manifest a marked regularity in their variations of visibility; a few, however (craters), depart considerably from the regular type, and it is for elucidating these irregularities that further and long-continued observations are requisite.

Eclipses of Jupiter's Satellites, and Occultations of Fixed Stars, Compared with the Nautical Almanac.

Mr. George J. Walker sends the following:—

			h.	m.	s.	
February 8.	1 Sat. Em.	G. M. T.	7	1	42.5	
		N. A.	7	1	43.3	
February 15.	1 Sat. Em.	G. M. T.	8	57	56.2	
		N. A.	8	57	41.0	
February 10.	M. Tauri. Disap.		9	6	11.2	G. M. T.
11.	χ^6. Orionis.—Only a near appulse in this place.					

A Brilliant Meteor.

The Rev. S. J. Johnson observed "a very bright meteor" on February 11 at 12h. 10m. It "started from a point 10° to the E of α Cephei, shot downwards in a slanting direction, and disappeared just below that star. It was brighter than Venus, and shot forth several sparks in its passage, and remained in sight two seconds."

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The Trapezium in the Nebula in Orion.

Mr. Edmund Salter again distinguished 9 stars in the Trapezium on the nights of January 25 and 29. On the former date he suspected the existence of a 10th.

TYCHO BRAHE'S TEMPORARY STAR.—It may not perhaps be very premature for observers to examine now and then the place, R. A., 4° 20′ decl. + 63° 24′ (1865), where Tycho Brahe's famous temporary star blazed forth in November 1572, and to notice if there is an increase of magnitude in the small star (10½ magn.) observed by D'Arrest very near that position. (See "The Heavens," pp. 364–66. Humboldt, "Cosmos," vol. 3, pp. 133–35.) A *mean* of the probable epochs gives 1885 for the time of its next maximum; but the two (supposed) past periods being 319 and 308 years, if the decrease proceeds at the same ratio, we should have 297 + 1572 = 1869. Smyth wrote in the "Cycle" (p. 56): "As there are vague impressions that similar stars appeared in 945 and 1264, Sir J. Herschel thinks it possible another such appearance may take place in 1872 or thereabouts. Telescopes will then be applied, owing to the want of which in 1572 it could not be ascertained whether the stranger had any sensible diameter."

Cassiopeia is out of my reach at present. Mr. Grover, who has given us an interesting survey of this constellation, will perhaps tell us if there is any variation in D'Arrest's little star. In Guillemin the R.A. is marked 4h. 20m., which does not agree with the diagram. It is probably a misprint for 4° 20′. G. J. W.

COMETS.—The Imperial Academy of Sciences at Vienna has promulgated a circular of some interest concerning comets. It begins by reciting that, whereas many new planets have been discovered of late years, the new comets detected have been comparatively few, and that notwithstanding that additional information concerning comets, far more than with small planets, is likely to add much to our knowledge of the universe. The circular then goes on to announce that the Academy will award eight gold medals a year for three years to the discoverers of new comets complying with certain conditions laid down. These, in substance, are that the discoverer claiming a medal shall be able to show that he was the first discoverer, and that the comet was not predicted. Every discovery must be communicated at once by telegraph to Vienna, accompanied by particulars of the comet's place. The astronomers of the Vienna observatory are constituted referees that the conditions of the discovery comply with the circular. The prizes will be awarded annually in May.—*English Churchman.*

The Astronomical Register is intended to appear at the commencement of each month; the Subscription (including Postage) is fixed at **Three Shillings** per Quarter, *payable in advance*, by postage stamps or otherwise.

The pages of the *Astronomical Register* are open to all suitable communications. Letters, Articles for insertion, &c., must be sent to the Editor, Mr. S. GORTON, *Parnham House, Pembury Road, Clapton, N.E.*, **not later than the 15th of the month.**

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The Astronomical Register.

No. 89. MAY. 1870.

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ROYAL ASTRONOMICAL SOCIETY.

Session 1869–70.

Sixth Meeting, April 8, 1870.

W. Lassell, Esq., F.R.S., *President*, in the chair.

Secretaries—Mr. Huggins, F.R.S., and Mr. Stone, F.R.S.

The Minutes of the last meeting were read and confirmed.

Thirty-seven presents were announced, and the thanks of the Society given to the respective donors.

Lieut. W. de Abney, C. J. Lambert, Esq.,
R. Abbay, Esq., E. H. Riches, Esq., LL.D.,
Wm. T. Bayne, Esq., G. M. Seabrooke, Esq., and
Herbert Tomlinson, Esq.,

were balloted for and duly elected Fellows of the Society.

The following papers were announced and partly read:—

On the Orbit of the Comet of 1683: by Mr. Plummer.

The comet was first seen by Flamsteed on the 3rd July, who observed it up to the 1st September. It was also observed by Hevelius. From the observations of Flamsteed an orbit was calculated by Halley, which was parabolic in form and of which the elements were given. In a recent number of the *Astronomische*

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Nachrichten, Claussen, the Director of the Dorpat Observatory, has published the elements of an elliptic orbit, which he has deduced from the observations. The period given is 189·7 years, and the return to perihelion might therefore be expected in 1873. Mr. Plummer, at Mr. Hind's suggestion, has recalculated the orbit, making all possible corrections, and using the most recently obtained places for the stars of comparison, and finds a parabolic orbit represents the observations much better than any other, so that a return of the comet in a few years is not to be looked for. The observations of Hevelius were also rigorously reduced, but they were not equal to those by Flamsteed.

Observations of the Lunar Eclipse on January 17, 1870: by Mr. Tebbutt, jun.

The eclipse was remarkably well seen in New South Wales. At the commencement a thin filmy cloud covered the moon, but it soon disappeared, and the sky remained unclouded afterwards during the eclipse. Local mean times of the contacts and various phases were given, but these are obviously very difficult to fix. During the totality the shadow assumed a light copper-coloured tint, except at the edges of the disc, where it became green. The details of the lunar surface were quite perceptible in the dark shadow. Several telescopic stars were seen near the moon which it was evident would be occulted during the eclipse. This accordingly happened, and the times of several such occultations were given. The copper and green tints remained after the total phase was over. The telescope employed was a refractor of $3\frac{1}{4}$-inches aperture, 48 inches focal length, and power 30.

Capt. Noble enquired how the contact of shadows could be given to seconds as Mr. Tebbutt did?

Mr. Stone replied that Mr. T. only said they were noted as well as possible.

Capt. Noble: If they are within 30 seconds, it is as much as could be done.

On the Floor of Plato: by Mr. Birt.

In a paper read last November, the author showed the degree of visibility of the spots on this part of the moon's surface. The spots were then 25 in number, and the table referred to 16 of these. Continuing the subject, the author had now to state that 35 spots were now known (a diagram being exhibited), of which 8 had been discovered since November 27, 1869, in the course of 531 observations made since that date. The paper contained a table of the degree of visibility of the spots for the first 6 lunations of a year, for the second 6 lunations, the increase or decrease of each, and the average visibility for the year deduced from 771 observations. An increase had been found in 10 and a decrease in 11. Spot 3, which was a *craterlet* observed by Mr.

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Dawes, showed the greatest decrease, and spot 19 the most increase, the extent of variation being very irregular. In a few instances only were they equally affected. Numbers 2 and 18 show the same increase of visibility. The greatest number of spots was always seen about the time of full moon. On comparing the series in which no more than 7 spots were seen, it was found that 5 were constant, but the remaining 2 were not the same, but varied exceedingly; some of the most difficult spots having been found on these occasions. Another year's observations, at least, would be required to work out the subject.

Professor Pritchard enquired what telescopes had been used.

Mr. Birt: They varied from 6 to 9-inches.

The President: Reflectors or refractors?

Mr. Birt: Both. The greater number of observations was made with Mr. Crossley's 9-inch refractor.

Studies of the frequency of Sun Spots and their connection with the Magnetic Declination: by Professor Wolf.

This paper was taken as read.

The President said that the next subject to be brought before the meeting was the Total Solar Eclipse of December 22nd. There was a probability that the Admiralty might furnish a ship, like the *Himalaya* in 1860, to take observers to the stations and bring them back, and it became very important to know how many were likely to go. The three principal points appeared to be Xeres (near Cadiz), Oran, and Syracuse. The first and last seemed most suitable for an English expedition, Oran being left to the French. The first and most important observations were those to be made with the spectroscope, and others would be the photographic operations, eye observations, and those with the polariscope. If the stations were confined to two in number, about 40 observers and assistants would be required, and he should be glad to receive offers to volunteer from any gentlemen present. The Council had determined to issue a circular to the Fellows, requesting those who entertained the question of going out to let them know what kind of astronomical work they were disposed to do.

The Astronomer-Royal said that, as an humble servant of the Government, but by no means in its confidence, he thought he might usefully open the discussion by pointing out the local circumstances of the case, so that it might be ascertained first how many observers could be calculated on as likely to join the expedition. The eclipse shadow first touched land on the coast of Portugal, but the earliest habitable station was Xeres. Next came Gibraltar, which was easily visited and contained much that was interesting. Then came Oran in Algeria, which might be fairly left to our excellent neighbours across the Channel, who

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were never behind in matters of science; and then Sicily. The central line passed near Syracuse, but he had a preference for Catania, at the foot of Etna, which he knew to be an agreeable locality. The shadow then passed over a desolate part of Greece and finished at the Black Sea between Balaclava and Sevastapol. There was no knowing where individuals might choose to go, but having sounded the Government, he thought it could hardly be expected that any money would be voted, but should any ships be disposable about the time, the observers might get conveyed to Gibraltar or Oran. As to Syracuse, however desirable as offering the chance of a better atmosphere, he had great doubt. It was much further off, and it was too much to expect that the Spanish observers should be landed so long before and have to wait so long after the eclipse, while the vessel went to Sicily and back. The only alternative will be to send two vessels; one for Gibraltar, and another to Sicily. Looking to the season of the year, and the voyage over the Bay of Biscay, he was afraid there would not be many offer to go; but fortune favours the brave, and he could assure them that if they saw the eclipse they would be amply repaid. His information was very meagre at present, but he was sure nothing would be done until the probable numbers were ascertained. Let them make a distinct proposal to the Government, and then they would get a distinct answer. Turning to the nature of the subjects of observation, he must observe that the time was very short (about two minutes), and that this would tend to confine the energies of the observers to one direction. The general opinion seemed to be that the subject of greatest importance was the nature of the corona; and here he must advert to a matter personal to himself. He had seen it stated in a newspaper and elsewhere, in support of a theory that the corona was an atmospheric phenomenon, that he held that opinion; but in order to show that this was incorrect, he quoted some extracts from his lecture at Manchester in 1861, showing what was his idea at the time, viz., that though it was possible the corona might be due to something of the nature of an atmosphere reflecting light, that something must be at least as far off as the moon was, and not at all the atmosphere surrounding the earth. The observations made in India and America had thrown great doubt upon the result of the experiments as to the polarisation of the corona, and he was afraid much ignorance prevailed upon the subject of polarisation, and that the observers did not know what polarisation in a plane passing through the sun's centre meant. He thought, therefore, before the expedition left, it would be necessary to have a sort of Polarisation Academy, and the observers should submit to an examination as to their competency. He

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would suggest Professor Stokes as the proper person to test these parties. Unless this were done he should distrust the observations of the class in question; and as the corona was a very important object at this eclipse, he hoped the matter would not be neglected. With respect to the weather prospects, it should be remembered that it was the time of the winter solstice. Upon this point, however, he had much pleasure in introducing Lieut. Brown of the Royal Artillery, who, from his experience at Gibraltar, could give authoritative information on the subject.

Lieut. Brown said he had been called upon rather unexpectedly, but he must say that if he had to select the time for an eclipse he could not desire a better one than the end of December for Gibraltar. From an experience of six winters there as a photographer, he was satisfied that there were few climates to compare with it. He always selected that season for his work, as the light, though not so intense as in summer, gave the most perfect definition. He was afraid to say more on this head, or they might be overrun with photographers. Xeres was also an excellent place. The expedition would be received with open arms at Gibraltar, and every assistance given to it. Should a Levanter set in, which was the only fear, they could adjourn to St. Roque or further inland. A hurricane or rain was very unusual at that time, and in the absence of such, the weather was sure to be very good.

Admiral Ommaney desired to confirm Lieutenant Brown's statement in every respect, and to say that he knew no climate so agreeable as that of Gibraltar in the winter. At Xeres also they would find plenty of accommodation, and a month might be spent very pleasantly in the neighbourhood, many objects of interest being there. The climate of Syracuse was by no means so good as that of the south of Spain, and he thought the accommodation would be defective. Lieut. Brown had carried on hi work zealously and creditably, and his opinion should be o great weight. It might not be generally known that there was a Spanish observatory at St. Fernando, about three miles from Cadiz.

Lieut. Brown said he had taken some steps towards setting up an observatory on a small scale at Gibraltar.

The President thanked Lieut. Brown for his valuable information, and said it was a surprise to hear such favourable accounts of the climate of Gibraltar, as it had generally been assumed that Sicily would have the better weather.

Admiral Ommaney: The climate of Gibraltar is the best in the world in winter.

The President: As to that of Xeres?

Lieut. Brown: I do not know so much about that. I think it is hardly so fine as ours.

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Admiral Ommaney: There is a rail from Cadiz to Xeres, and steamers run every day from Cadiz to Gibraltar.

The President: As to the weather at Oran?

Admiral Ommaney: It is almost as favourable as at Gibraltar all along the opposite coast.

Mr. De la Rue wished to make a few remarks on the subject of the observations to be made, and especially to point out that the corona might consist of two or three distinct matters. The protuberances were admitted to belong to the sun, and he thought that portion of the corona nearest to it at least belonged to the same body, because, although the outline was indistinct and escaped the eye, the photographs taken showed that the moon covered and uncovered it exactly as it did the sun itself at opposite limits. This part should be tested by the polariscope, but he did not think the light would be found polarised. He believed it would show bright gaseous lines in the spectroscope. It must be carefully examined to see what this was. Every person who had seen an eclipse knew that the prominences were most distinct in shape and persistent in form for some time, but rapid changes were visible, under recent modes of observation, between the protuberances, and this part was the most important of all for future investigation.

Mr. Vignolles would say nothing about the astronomical points, but had much pleasure in informing the Fellows that Signor Montesino, to whom the *Himalaya* expedition was so much indebted in 1860, was now Vice-President of the Cortes, and would render every possible assistance to astronomers going to the central line in the south of Spain, with which he was well acquainted, and could ensure them accommodation. Mr. Vignolles intended to go himself if at all possible, and thought they should at once select their ground, and he hoped he should be rewarded with the sight of an eclipse at last.

Mr. Chambers, as one wishing to take part in the observations, enquired the probable time that would be occupied. He had heard it would take three weeks.

The Astronomer-Royal: A month had better be allowed.

Mr. Chambers also enquired as to the position of the observers. Would they be independent, or considered as attached to an organised staff?

The Astronomer-Royal said the Government would not put any claim on the observers. They would only be too happy to put all the detail of the arrangements off upon him or somebody else. Still, it was very desirable that the parties should meet and organise themselves, although there would be neither legal nor military power over them. On starting the *Himalaya* expedition, a sort of parliament was held on board and different stations taken

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up. Now he hoped that the names would be known much earlier, and a change had taken place—the observations had resolved themselves in several distinct trains, and these should be appropriated and provided for. He had collected three good 6-inch telescopes and four good 4-inch ones for the transit of Venus observations, and he had no doubt of being authorised to lend these for the eclipse observations, but it was very desirable to know what persons and instruments would be available as soon as possible.

Mr. Huggins stated what he considered would be a good organisation with regard to the spectroscope observations. At each station three instruments at least would be required; one to observe the light between the prominences, another for the prominences proper, and the other for the light of the corona at a greater distance from the sun; and as this light would be faint only a low power could be used and all the spectrum could be seen at once in the small telescope of the instrument, and one individual could do all the work. But with respect to the other two objects, the prominences and the bright part of the corona, they gave considerable light, and great dispersive power might be applied to them. Then, the time being so short, one observer could not examine the whole of the spectrum, but it should be divided, one taking from the red end to *b*, and the other from that point to the most refrangible end of the spectrum. It would, therefore, be better to have two telescopes and spectroscopes for each of these two objects. It was necessary that the prominences should be observed, although their constitution was known, in order to discriminate between the light of a prominence and that between us and it going round the limb. Five spectroscopes would therefore be wanted at each station; two for the prominences, two for the corona, and one for the outer part of the latter light. Each instrument would require three persons—one would have the most interesting post to look into the instrument; another to keep the limb of the sun where the desired object was direct upon the slit of the spectroscope, and the third to record the phenomena seen. Three observers would thus be wanted for four of the five spectroscopes, but only two for the outside part of the corona, viz., one to observe and one to record; making fourteen for each station, to have the work done satisfactorily. He hoped they would have volunteers for the less interesting part of these operations.

Colonel Strange thought that the present discussion was calculated to do much good, irrespective of the mere observations of the eclipse. Mr. De la Rue shows that the study of photography must be taken up; Mr. Huggins that a considerable number of skilled spectroscope observers will be required; Mr. Airy says that there is ignorance as to polarisation. Now, in the

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present state of our knowledge, if the eclipse were to take place next week it is probable the observations would break down. Such delicate requirements as those of Mr. Huggins could hardly be met without previous training. He believed the thorough organisation which must take place before the journey would bring about a vast improvement by the acquisition of knowledge and habits of thought among the observers, and thus a great gain to science generally. He hoped this idea would be impressed upon the Government, as well as the object of unveiling the solar constitution; and with this advance of general science in prospect, he could not imagine any aid that was asked would be refused.

The President enquired how many photographers and observers in other departments would be wanted?

Mr. De la Rue: Five persons would be required for each photographic apparatus.

The President: And for polarisation?

Mr. De la Rue: As many as like. The observations are not difficult if they know what they are about.

The Astronomer-Royal suggested that the circular should request an answer by the next meeting of the Council, and that it should enquire what instruments could be contributed.

At the request of the President Mr. Huggins read the proposed circular.*

Capt. Noble said he should be very sorry to discourage any spirit of scientific observation, but he hoped it would be understood that no mere idle spectators were wanted in the expedition, and that those who volunteered would take the parts assigned to them without grumbling.

Mr. De la Rue: They must remember they will have no time to look about.

Mr. Huggins: Those appointed to keep the sun's limb on the slit of the spectroscope will see very well.

Mr. Stone: With reference to the polarisation observations, it should be remembered that at the eclipse of 1860 Mr. Beck took out with him the most delicate means of testing the light of the corona, but found himself unable to decide as to the plane of polarisation. If the account of the Indian observers in 1868 be read with care, it will be seen that they get confused as to whether the centre of the field of their instruments was black or white. They are certain of the polarisation, but not of the plane. All the observers in India in 1868 report that the plane passes through the sun's centre, and all the American observers in 1869 say it does not. The argument used by Mr. Proctor at the last meet-

* This will be found on another page.

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ing as to the nature of the corona has nothing to do with this. The question is not, whether the light is polarised, but as to its plane.

The discussion on the eclipse expedition having closed, the President stated that Mr. Watson of Durham desired to offer some remarks on a question connected with the constitution of *the Moon* to the meeting.

Mr. Watson said he had not prepared any paper on the subject of his views respecting the moon, not knowing that he should be detained in London till this evening. The same cause deprived him of the models and diagrams he generally used. The moon had been for many years a pet study of his, and he had lately arrived at certain interesting results respecting it. For 18 years he had studied the geology (so to speak) of the moon, and found it indicated that its surface had been considerably shattered by volcanic eruptions. Now, if like produces like, by analogy with the earth such eruptions could only be the result of the existence of air and water. He admitted fully that these bodies were not existing on the side seen by us, but might they not be on the other side? Hansen states that the visible side of the moon is in the position of an elevated plateau upheaved 10 miles at least; and as he (Mr. Watson) could not understand how volcanic action could take place without air and water, which must still exist, and there being no trace of them to be seen on one side, why they must be on the other, otherwise we were on the horns of a dilemma. The steps of his reasoning were chiefly geological and chemical, and he was not sure they would be a proper communication to this Society, but if this were allowed he would prepare a paper and show that if, ages ago, the action took place which upheaved mountains and craters, the existing cause of those eruptions must still be there. He thought so ten years ago, but could see no ground for the assertion; now he felt that they could not get away, and as they were not on the visible side they must be on the one turned from us. On two occasions he had addressed geological and chemical societies on the subject, and they appeared convinced by his arguments and illustrations, and he would stake any little reputation he possessed on the statement that the air and water existed still on the moon. They could not be seen, but they could be perceived. He assumed that the knowledge of volcanic action being due to water was admitted, and then, as the evidence of volcanic action was ample, if the water existed once it must be there still, and if not on one side must be on the other.

Capt. Noble said he seemed to have read something like this before, and referred to Sir John Herschel's work on Astronomy in Lardner's Cabinet Cyclopædia, which subsequently developed into

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the *Outlines of Astronomy*. The author there suggested that, supposing water to be present on the moon, it must be vapour on one side and ice on the other, with condensation going on at the terminator; but Sir John Herschel by no means asserted this to be the case, and the facts of observation were all against it. Mr. Watson's remarks reminded him of the American who said, "There's nothing new and nothing true, and it don't signify." The theory had been indicated before, but never proved, neither had this been done now.

The President thought some proofs should have been adduced in support of the opinion if it were to be brought forward at all.

Mr. Watson said he could never hope to see the air and water, but they were distinctly visible to his mind's eye. Water must have existed, as the beds and banks where it had escaped were clearly visible. He was quite satisfied as to this, and then was obliged to ask himself where it had gone to. For a long time he could arrive at no conclusion, but one day he heard the nursery rhyme,

> There was an old woman lived under a hill,
> And if she's not gone she lives there still,

and this gave him great relief. As one acquainted with chemistry and physics, he felt that it could not be annihilated, and if not found on one surface it must be on the other. He admitted the somewhat similar view indicated in the work referred to, and thought the inference so good that he had carried it further.

Colonel Strange said that the gentleman who had favoured them with his views addressed a letter to the Council asking permission to do so, and stating that he desired the opinion of the Society as to their correctness. He (Col. S.) therefore thought it desirable that Mr. Watson should be informed by the Chairman that the Society never gave any such opinion on the communications made to it; and that even if the distinguished astronomers present did not rise to refute him, he must not assume that "silence gives consent." As an example of the fallacy of Mr. Watson's reasoning, it might be mentioned that, granting the volcanic action and the cause of it, and granting there was no escape of the water from the moon, there might be another explanation than that it was on the other side. It might be in the middle of the moon, having been absorbed through fissures, and ready to perform its functions over again if required. He (Col. S.) did not think this was the case, but it showed we were not on the horns of Mr. Watson's dilemma, and proved what a dangerous experiment it was to argue without any facts to rely upon. The appearances of volcanic action had been heard of before to-day, and nothing further had been adduced to support the hypothesis founded on them.

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Mr. De la Rue fully concurred in all that had been said by Colonel Strange, and would recall to Mr. Watson's recollection, as a chemist, that even if the water changed its place the air would be left to take care of itself. He thought Mr. Watson had better reflect further on the subject before publishing his views.

Mr. Stone remarked that Herschel had referred to this point, and what he said had been connected with Hansen's statement as to the non-coincidence of the centre of figure and centre of gravity. Some doubt as to whether Hansen had sufficient grounds for his conclusion have been raised by Sir J. Lubbock, Professor Newcombe, and M. Delaunay, and it is understood Hansen will go over the work again. It is much to be regretted that he does not at once come forward and state his reasons for the assertion, as all the present discussion hinges on that.

Mr. Browning enquired whether it was not a question of temperature? Physicists had come to the conclusion that the temperature of space was 180° or 140° below zero, therefore water on the other side of the moon would become ice. Then when the sun shone there it would be vaporised, forming clouds and obscuring occultations, which never happened.

Capt. Noble: It is clear there must be a film of vapour at the junction of light and darkness under such circumstances.

The President stated that, as previously remarked, the Society refrained from expressing any opinion on the hypothesis. The views of those gentlemen who had spoken on the subject were very evident.

Mr. De la Rue remarked that photography afforded the means of throwing light on the question of the difference of the centre of gravity and centre of figure. If there were a protuberance of either side it would give in the pictures distinct evidence of a physical libration; and although the quantity would be very small, it was quite within the range of astronomical photography.

The meeting then adjourned.

Erratum in last report, page 71, line 13.—For *unilluminated* read *illuminated*.

Aurora Borealis.—At 7.50 G. M. T. on April 5, 1870, while observing the moon, my attention was arrested by a large mass of red light of an irregular form in the N.W. part of the heavens, other masses being seen in different parts of the northern sky. One of these appeared to shoot up from the horizon as a more or less rectilineal beam, which covered the Constellation Cassiopeia, the stars being seen distinctly through it; another beam of the same light was seen in the direction of the Northern Meridian. At first I did not see any auroral light near the horizon, but I observed that the two masses which I saw at first drifted towards the prime vertical (west) with a very perceptible motion, that of an irregular form

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completely enveloping the planet Jupiter, which was shining brightly at the time; it also passed over the Pleiades, but did not reach the moon. At the same time the beam from the horizon passed away from Cassiopeia to Perseus. While observing these, the horizon became lighted up from the N.W. to a point E. of N., but not equally so: the light was more intense at the bases of the coloured beams, that near the Northern Meridian shot upwards towards the pointers in Ursa Major, and drifted in the same direction as the others until it passed over Polaris. A well-defined Auroral arch was noticed about 8.10. G. M. T. The contrast of the whiter light of the arch and its fitful character, with the rosy or crimson hue of the drifting beams, was very interesting, also the undefined outline of the larger western mass as compared with the general regularity of outlines of the beams.

Walthamstow: W. R. BIRT.
April 5, 1870.

CORRESPONDENCE.

N.B.—We do not hold ourselves answerable for any opinions expressed by our correspondents.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

THE SUPPOSED PLANET VULCAN.

Sir,—The observations for the suspected intra-Mercurial planet terminated on April 10, and during the time that the sun was under examination no planetary body was visible in transit. The weather was, on the whole, exceedingly favourable for solar observations throughout the entire period selected for the search, and the spots on the sun have been both numerous and large. Many of them presented some remarkable characteristics, and were observed to undergo very rapid changes in their form. The most noteworthy alterations in the appearance of the spots occurred in the luminous bridges which sometimes cross the umbræ of large *maculæ*. Mr. E. B. Knobel, of Burton-on-Trent, was an observer of a phenomenon of this character. He says:—"March 26. I began to observe the sun at 10.40 A.M. and gave my attention almost entirely to examining the large spot visible in the sun's northern hemisphere. I made a sketch of it, which I completed by a few minutes after 11 A.M. At 11.10 the sun was obscured by clouds which cleared off at 11.15 G. M. T. I immediately directed my attention to this spot, and was astonished to observe a change had taken place in the bright bridge across the umbra. A brilliant patch seemed to have broken out in the middle of the bridge. The moment I had the spot in the field of the telescope it attracted my attention, and I felt confident it had not presented that aspect when it had clouded over 5 m. before. I should say the bridge was much brighter than the penumbra. I hope other observers may have noticed the same phenomenon."

Several of the clusters of spots, and large single spots, have been distinctly visible to the unassisted eye. On March 31, at sunset, the sun was enveloped in a dense fog, and I saw without difficulty two of the groups and a large isolated spot near the W. edge, and am very confident that another cluster on the E. edge was also perceptible without telescopic aid. Mr. E. B. Knobel also saw one or more of the spots with the naked eye on March 25, 26, 27, 28 and 30, and several other observers have also perceived two or three of the spots without instrumental assistance.

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On April 5 an immense group became visible on the E.N.E. edge, and as it approached nearer the centre of the disc it presented a most extraordinary appearance. Mr. T. G. E. Elger, referring to this cluster, says:—"April 6. I counted more than 70 spots within the penumbra," and Mr. Thomas Wilson, of Skipton, obtained some measures, on the 7th, of the dimensions of this penumbra, which he found to equal 162″ in length and 129″·5 in width. Taking 450 miles as the value of 1″ on the solar surface, the penumbra must, therefore, have extended over 72,900 miles in length and 58,275 miles in width. Mr. Elger states:—"The most rapid and extraordinary changes were remarked in the long straggling umbra of this spot. There were evident traces of cyclonic action going on, shown by the spiral streaks and markings within the penumbra. I have been in the habit of constantly observing large solar spots during the last ten years, but I never witnessed such a changeable group before."

Mr. W. R. Birt, F.R.A.S., referring to a small group of spots visible on the 6th, says:—"April 7. This group has become enlarged, still more assuming the character of two other conspicuous clusters; one in the S. the other in the N. hemisphere, consisting of two spots, one preceding and the other following the central portion or focus of disturbance; a feature which I constantly noticed in my sun-spot observations nine or ten years ago."

Mr. Birt also remarks that the spots, "which have recently been very numerous, may be divided into two classes: large isolated spots or pairs of such spots, attended with comparatively small penumbræ, and preserving from day to day their distinguishing characteristics; and large groups, of magnificent proportions, containing numerous umbræ and a large extent of penumbræ, the disposition of which altered greatly from day to day."

Observers agree in stating that, during the period selected for the observations, they have not been able to obtain good definition with high magnifying powers.

In a future series of observations I intend to endeavour to obtain the co-operation of observers situated at more distant stations, for inasmuch as the recent observations have been exclusively confined to observers in the British Isles, the sun has escaped systematic examination during nearly half the day of 24h.

I am, Sir, truly yours,
WILLIAM F. DENNING,
Hon. Sec., O.A.S.

Ashley Road, Bristol,
April 16, 1870.

SPOTS ON THE SUN.

Sir,—I was standing in the garden about a quarter past 6 on Sunday evening (April 3), when I chanced to look at the sunset, and immediately saw a large black spot on the sun's disc. It reminded me at once of a sun spot, but I had never heard of spots being visible to the naked eye, and I endeavoured to ascertain by observation the nature of the spot I could see. I watched it for full half-an-hour, during which time several small clouds drifted across the sun's disc from north to south apparently, and in their passage dimmed the spot and once completely obscured it; but they had no sooner passed over than the spot was again plainly visible,—a black spot on the red disc of the sun. The sun was now sinking fast, but the spot sank with it, which circumstance seemed conclusive in my mind as to its being a sun spot. At length the spot was obscured by the thick mist into which the sun sank.

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On the following evening (Monday) I again saw a similar spot on the disc, but was not enabled to observe it so long, as the sun had already sunk low, and was soon obscured in the bank of mist at the horizon. I was thinking of writing to some scientific periodical and cautiously asking if any great sun spot was at this time visible, when I received a letter from an astronomical friend, who mentioned incidentally that an immense spot was at present passing across the disc. The next morning, i.e. to-day (Wednesday, April 6), about 10 o'clock, I procured a piece of smoked glass and looked at the sun through it, when the spot was immediately visible, though it had apparently moved somewhat nearer the edge of the disc than it was on Sunday evening. I called three persons to me, one an agricultural labourer, and neither possessing any astronomical knowledge, and, handing them the smoked glass, asked them to look at the sun, without giving them any idea what to look for. All three at once exclaimed that there was a spot on the sun, and all agreed as to its position. Subsequently I obtained a telescope, which set the question at rest at once, by revealing a large spot and several smaller ones. Not remembering any parallel instance of seeing a sun spot with the naked eye, I venture to communicate my observation, and to append a rough diagram of the apparent position of the spot when I first saw it on Sunday.

I remain, yours respectfully,

Coate, near Swindon, April 6, 1870.

RICHARD JEFFRIES,
Editor, Wilts and Gloucester Standard.

[At the beginning of the month of April, spots on the sun were visible easily without optical assistance. Our correspondent's diagram represents the spot on the upper part of the sun's disc to the left hand.—Ed.]

DOUBLE STAR ORBITS.

Sir,—I have been trying my hand the last week or two at working out some double star orbits, using the observations in Mr. Brother's catalogue, published in the *Register* in 1867, and not being sure that I have got hold of a right way, I should be glad if some fellow-reader could help me out.

I will first describe the method I have pursued.

I have taken the dates and angles of position and laid down the intervals to scale, making the years abscissæ and the angles ordinates. Through the points thus got I have drawn a curve as accurately as I could, and drawn tangents for the angular velocities at those points. Then assuming that the distance varies inversely as the angular velocity, I have laid the orbit down on card, and after carefully completing what seems the most likely ellipse, have measured the position of the major axis and the eccentricity. Then, cutting out the whole ellipse, and weighing the sector corresponding to the observed period and the whole, I have deduced the periodic time.

In this way I have obtained the following for η Corona:—

Position, major axis, $= 55^\circ$
Eccentricity, $= 0{\cdot}833$
Period, $= 62{\cdot}1$ years.
Periaster, 1853.

This process seems to me, however, not quite reasonable; for although it would answer if the plane of the orbit were at right angles to the line of sight, when this is not the case the apparent angular motion may be very different from the true.

Some years ago I tried the process on γ Virginis, and, if I remember

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rightly, brought out results agreeing pretty well with the latest determination given in the Bedford Catalogue.

Hoping that somebody may be able and willing to assist me in this matter,

I am, Sir, yours truly,

Scarborough: April 11, 1870. T. H. WALLER.

D'ARREST'S COMET.

Sir,—The following ephemeris of this body for the month of May will be useful to some of your readers:—

Berlin Mean Moon.

1870.		R.A. h.	m.	s.		N.P.D. °	′
May 1	...	16	13	36	...	81	45
3	...	16	12	42	...	81	19
5	...	16	11	40	...	80	53
7	...	16	10	32	...	80	28
9	...	16	9	18	...	80	3
11	...	16	7	57	...	79	39
13	...	16	6	30	...	79	15
15	...	16	4	58	...	78	53
17	...	16	3	20	...	78	32
19	...	16	1	38	...	78	11
21	...	15	59	52	...	77	52
23	...	15	58	1	...	77	35
25	...	15	56	8	...	77	19
27	...	15	54	12	...	77	4
29	...	15	52	15	...	76	52
31	...	15	50	16	...	76	41

I remain, your obedient servant,

Windyhills Observatory, Bickley: G. F. CHAMBERS.
April 4, 1870.

OBSERVATION OF VENUS, NEAR HER INFERIOR CONJUNCTION.

Sir,—In your report of the meeting of the Royal Astronomical Society of March 11, on p. 71, I am made to assert the precise reverse of what I really said.

So admirably accurate, as a rule, are your accounts of our meetings, that I am a little uncertain whether this error is referable to your reporter or to myself in giving an unintelligible *vivâ voce* description of my observation of Venus, instead of reading from my paper. Under any circumstances though, I must ask your leave to correct the mistake.

What I intended to say, and what I believe I did say, was, that the *illuminated crescent* of Venus was less than a semicircle, or that the chord joining its cusps was less than a diameter. It was the dark limb of the planet which I could not trace right round, its northern part seeming to melt into the surrounding sky.

I am, Sir, your most obedient servant,

Forest Lodge, Maresfield, Sussex, WILLIAM NOBLE.
April 9, 1870.

[See correction in present *Report*.—Ed.]

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OCCULTATION OF THE PLANET SATURN.

The following letter from Mr. Hind appears in the *Times*, April 21:—

The first of three occultations of the planet Saturn visible in this country during the present year was very favourably observed here this morning by Mr. W. E. Plummer, with Mr. Bishop's large refractor, under a magnifying power of 260. The following are the recorded mean times at this observatory (situate 1m. 13·1s. west of the Royal Observatory, Greenwich), in lat. 51° 27′ 4″:—

At the Immersion.	A.M. h. m. s.
Outer edge of outer bright ring	2 54 8·6
Inner edge of inner bright ring	— 54 20·3
Preceding limb of ball	— 54 36·5
Following limb of ball	— 55 10·4
Inner edge of inner bright ring	— 55 28·4
Outer edge of outer bright ring	2 55 40·8

At the Emersion.	A.M. h. m. s.
Outer edge of outer bright ring	4 2 52·4
Inner edge of inner bright ring	Not observed
Preceding limb of ball	4 3 21·1
Following limb of ball	— 3 55·8
Inner edge of inner bright ring	— 4 11·7
Outer edge of outer bright ring	4 4 22·3

The difference of colour of the moon and planet was very striking. The great satellite Titan, which would at the time precede nearly on the parallel of declination, and at a distance of 11 apparent diameters of the globe, was not sufficiently distinct for observation. The exterior satellite, Japetus, then nearly in the same direction from the centre of Saturn, but at three times the distance of the large one, was, of course, invisible, from its much greater faintness.

The next occultation of Saturn visible in the metropolis will occur early on the morning of the 11th of July. The last occurred on the evening of the 8th of May 1859.

From the 19th to the 23rd of April is one of the periods at which unusual numbers of meteors have been remarked; during last night very few were seen here. The meteors of the April period are believed to move in an orbit closely approximating to that of the great comet of 1861, which became so suddenly and imposingly visible in these latitudes at the end of June, and is found to have a period of revolution rather exceeding 400 years.

The occultation was also observed by Mr. Talmage, with Mr. Barclay's fine refractor of 10 inches aperture, at Leyton, the power used being 110. At this place the appearance and disappearance of Titan were perceived.

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The following are the local sidereal times :—

	h.	m.	s.
Disappearance of Titan	16	41	17·35
First contact with ring	16	47	51·35
" ball	16	48	15·0
Final disappearance of ball	16	48	57·5
" ring	16	49	17·35
Reappearance of Titan	17	51	6·3
" ring	17	56	42·4
" ball	17	57	9·3
Ring clear of moon	17	53	12·5

The other occultations of the planet this year will be on July 10 and September 30.

THE ASTRONOMICAL INSTRUMENTS OF THE LATE DR. LEE.—The remaining portion of the instruments at Hartwell House was brought to the hammer by Messrs. Christie and Manson the latter end of last month. The transit instrument, 5 feet focus and $3\frac{3}{4}$ inches aperture, by Jones, was sold for 11 guineas; the sidereal clock, by Vulliamy, for £25 10*s.*; a Gregorian telescope, 5 inches speculum, 8 guineas; an equatorial stand, by Cooke, $14\frac{1}{2}$ guineas; a refractor, by Dollond, $2\frac{7}{8}$ inches aperture, 42 inches focus, complete, $14\frac{1}{2}$ guineas. There is some difference between these prices and those at which they were advertised in the *Register* in October last.

EXTRAORDINARY METEOR.—At a few minutes after eight this evening I observed a most brilliant meteor, in a southerly direction. The first appearance was about 40° above the horizon, apparently about six inches diameter, showing five or six brilliant jets of light; in about three seconds it reappeared at the apparent distance of about 15 yards to the westward, and the same twice subsequently at about the same distances and intervals, descending from the first to the fourth appearance about 10°. From other parts I hope you will receive accounts from astronomical pens. HY. WRIGHT, Albion Villa, Church End, Finchley, April 19.—*Standard.*

FALL OF A MONSTER AEROLITE.—A Tripoli (Barbary) letter reports the fall of a monster aerolite in the neighbourhood of Mourzouk, weighing, it is said, 1,800 okes (nearly 5,000lbs.). This must, of course, be only a rough guess, but if it be even tolerably approximate, the mass is one of the largest meteoric bodies on record. Be its actual size what it may, the Minister of Public Instruction has ordered the fragment to be sent to the capital, where it will probably be placed in Mr. Goold's museum. *Levant Herald.*

NEW MINOR PLANET.—Another of these bodies has been discovered by M. Borelly, at Marseilles. Its position, April 19, was, at 10h. 33m. 13s. R.A. = 13h. 2m. 39s.; Decl. + 6° 50′ 39″; horary movement in R.A., 1° 77′; in decl. + 2·206″. Magnitude 12·5.—*Daily News.*

MIRA CETI. — In reply to T. M. B., "The mean period is 331 d. 8 h., but it would appear from the researches of Argelander (*Astro. Nach.* 624), that this period is subject to a cyclical variation, embracing 88 such periods, which has the effect of gradually lengthening and shortening these periods to the extent of 25 days, one way and the other."—Chambers, *Descriptive Astronomy*, p. 485. See also, Herschel, *Outlines*, &c.—G. J. W.

NEW EYE-PIECE. — Can anyone tell me where the new eye-piece, invented by the Astronomer-Royal, can be obtained, and its price?—G. J. W.

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ASTRONOMICAL OCCURRENCES FOR MAY 1870.

DATE		Principal Occurrences		Jupiter's Satellites		Meridian Passage
		h. m.			h. m. s.	h. m. Venus. A.M.
Sun	1	17 31 20 20	Sidereal Time at Mean Noon, 2 36 50·9 Conjunction of Moon and Jupiter, 3° 30′ N. Conjunction of Moon and Mercury, 6° 24′ N.	The Satellites of Jupiter are invisible until June 20, Jupiter being too near the Sun.		— 9 4·9
Mon	2		Meridian Passage of the Sun, 3m. 10s. before Mean Noon			9 4·6
Tues	3		Declination of Venus: — 1° 36′ 17″			9 4·3
Wed	4	1 50	Greatest Westerly elongation of Venus 46° 5′			9 4·0
Thur	5	22 0	Conjunction of Moon and Uranus, 0° 42′ N.			9 3·8
Fri	6					Moon — 4 39·0
Sat	7		Saturn's Ring: Major Axis = 40″·49 Minor Axis = 18″·02			5 31·9
Sun	8	3 38	☽ Moon's First Quarter			6 24·8
Mon	9					7 17·2
Tues	10	23 33	Greatest Easterly elongation of Mercury 21° 34′ E.			8 9·4
Wed	11					9 1·7
Thur	12					9 54·7
Fri	13					10 49·3
Sat	14	11 29 12 21 18 3	Occultation of o^2 Libræ (6) Reappearance of ditto ○ Full Moon			11 45·8
Sun	15		Illuminated portion of disk of Venus = 0·550 of Mars = 0·993			12 44·5

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DATE		Principal Occurrences		Jupiter's Satellites		Meridian Passage
		h. m.			h. m. s.	h. m. Venus. A.M.
Mon	16	9 29 10 13 11 19 23 40	Sidereal Time at Mean Noon, 3 35 59·3 Occultation, reappearance of ξ Ophiuchi (5) Occultation of B.A.C. 5866 (6) Reappearance of ditto Conjunction of Moon and Saturn, 0° 43′ S.			9 2·3
Tues	17					9 2·2
Wed	18		Meridian passage of the Sun, 3m. 50s. before Mean Noon			9 2·2
Thur	19		Declination of Venus: + 3° 46′32″			9 2·2
Fri	20					9 2·2
Sat	21	18 9	☾ Moon's Last Quarter			9 2·3
Sun	22					9 2.3
Mon	23					9 2·3
Tues	24	14 34	Conjunction of Jupiter with the Sun			9 2·4
Wed	25	17 32	Conjunction of Moon and Venus, 3° 19′ N.			9 2·5
Thur	26					9 2·6
Fri	27		Saturn's Ring: Major Axis=41″·25 Minor Axis=18″·42			9 2·7
Sat	28	6 49	Conjunction of Moon and Mars, 4° 27′ N.			9 2·8
Sun	29	13 2 21 57	Conjunction of Moon and Jupiter, 3° 6′ N. ● New Moon			9 3·0
Mon	30	12 38	Conjunction of Moon and Mercury, 1° 27′ N.			9 3·1
Tues	31					9 3·3

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THE PLANETS FOR MAY.

AT TRANSIT OVER THE MERIDIAN OF GREENWICH.

Planets	Date	Right Ascension	Declination	Diameter	Meridian Passage
		h m s	° ′		h m
Mercury	1st	3 45 17	+22 5	6″·2	1 8·2
	17th	5 0 49	24 36½	9″·4	1 20·6
Venus	1st	23 44 54	− 2 12	24″·6	21 4·6
	17th	0 45 37	+ 3 3½	20″·8	21 2·2
Saturn	1st	17 51 35	−22 9	16″·2	15 12·2
	17th	17 48 14	22 8	16″·6	14 6·0
Uranus	1st	7 20 30	+22 38½	4″·0	4 42·9
	17th	7 23 0	22 33½	3″·8	3 42·5

Mercury increases in distance from the sun until the 12th of May, when the meridian passage takes place about one hour and twenty-five minutes after noon. The planet may then be observed setting after the sun in the evenings. At the end of the month Mercury passes the meridian about half an hour after noon.

Venus arrives at her greatest westerly elongation on the 4th of the month, passing the meridian about four minutes past nine in the morning, and the planet continues to transit within a minute or two of the same time until the end of May, forming, as during the last month, an excellent object for the transit instrument in the morning.

Saturn may be observed during the night, as the planet passes the meridian shortly after 3 o'clock in the morning, at the beginning of May, and about an hour before midnight at the end of the month.

Uranus may still be observed in the evenings, as the constellation Gemini, from its altitude, continues above the horizon for some time after sunset. The planet is, however, now passing away from us for the season.

ASTRONOMICAL REGISTER—Subscriptions received by the Editor.

To December 1869.

Dallmeyer, J. H.
Landell, W.

To May 1870.

Reside, J.

To June 1870.

Cook, J.
Hemming, Rev. F. B.
Jackson-Gwilt, Mrs.
Noble, Capt. W.
Potter, T., Jun.
Sargent, Rev. J. P.
Woodman, T. C.

To July 1870.

Shaw, Rev. J.

To September 1870

Burlingham, R.
Pratt, H.
Williams, Prof. M.

To October 1870.

Elvins, A.

To December 1870.

Abbott, F.
Crowe, Rev. R.
Freeman, D. A.
Hedgeland, Rev. J. W.
Hibbert, G.
Mestayer, R.

April 27, 1870. Subscriptions received after this date in our next.

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THE OBSERVING ASTRONOMICAL SOCIETY.

Hon. Sec. William F. Denning, Ashley Road, Bristol.

Report of Observations made from March 7 to April 7, 1870, inclusive.

Solar Phenomena.

During the above period of observation the sun's disc has exhibited many large and interesting groups of spots. Mr. J. W. Backhouse, of Sunderland, reports, that the penumbra of the largest spot visible on March 12, at 3h. 25m., was 50,000 miles in length; and on the 14th it had increased to 58,000 miles. On the 18th, at 21h. 30m., it extended over 89,000 miles. "At the latter date, the penumbra of another spot was 63,000 miles long, and that of a third about 77,000 miles; but I suspect that two of the spots were united, in which case the two together would be about 99,000 miles long! In any case, the penumbra has attained a greater length than any I saw during the last maximum of the 11-year period of the spots." On the 4th April the same group reappeared, and Mr. Backhouse made some further measures of the size of the largest spot. "On April 6, at 4h. 20m., it was 83,000 miles long and 64,000 miles wide, and was probably the widest penumbra I have ever seen. Its umbræ were, however, small in proportion, the largest being but 13,000 miles long. On April 8, at 21h. 30m. the penumbra of this spot was reduced to 67,000 miles in length and 48,000 miles in width. There was not, however, much change in the umbræ."

Mr. Albert P. Holden, of London, writes:—"The spots have been remarkably numerous, and very large. Nearly all of them have been very large single spots, crossed by numerous luminous bridges, or large areas broken up into masses of mixed umbræ and penumbræ. The following list gives an analysis of the spots visible on the several dates:—

Date.	Clusters.	Single Spots.	Total.	Great.	Large.	Small.
March 23	6 containing 26 spots	11	37	4	13	20
24	4 " 20 "	9	29	4	12	13
31	4 " 43 "	7	50	5	23	22
April 2	5 " 51 "	6	57	6	16	35
3	5 " 39 "	6	45	6	12	27
6	4 " 51 "	10	61	6	17	38
7	6 " 55 "	11	66	6	16	44

On March 25th, I observed one very large single spot completely isolated from any others, which showed some remarkable changes in appearance. At 7 A.M. it was crossed towards the upper portion of the umbræ by a forked luminous bridge; but at 7.10, while I was yet observing the spot, I

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was surprised to see a strange motion of the broad white bridge, which, in the space of less than 5 m., altered its appearance. A large triangular mass was partially detached from the light bridge (the irregular motion being quite perceptible), while lower down (apparently), a long bright tongue formed with equal rapidity, and nearly joined the N. edge of the penumbræ. At this moment, I particularly noticed that the long tongue had a very peculiar vibratory motion, like that of a strip of paper subject to a gentle draught of air; also, that in the neighbourhood of the bridge two white spots occasionally appeared and disappeared for at least a minute. The appearance of the spot after these surprising changes was much altered. I will add, that the air was rather misty at this time, and this might probably have caused the vibratory appearance of the long tongue and the phenomenon of the two white spots in the umbræ; but the startling changes first mentioned occurred in a clearer sky, and the motion was unmistakable. I observed the spot again on April 3, just as it was becoming invisible on the W. limb. Its appearance seemed unchanged, except that the part seen partially detached on the 25th was then quite separated."

Mr. Henry Ormesher, of Manchester, observed a spot on March 10, the penumbra of which enclosed two umbræ, and in one of these umbræ two nuclei were "plainly seen." On this date, 12 groups of spots were visible on various parts of the disc.

The Rev. S. J. Johnson has forwarded me sketches of some of the numerous groups recently visible. He says that, on April 2, at 4h., eighteen of the spots distinctly showed penumbræ.

The Planet Mercury.

On March 13, Mr. John Birmingham, of Tuam, observed this planet in bright sunlight. The disc was rather more than half illuminated, and he was pretty certain that he saw a large white spot near the E. limb.

The Planet Venus.

Mr. A. P. Holden says:—"The W. elongation of this planet affords a fine opportunity for daylight observations of it. Many who, at its evening appearance lately, failed to pick it up until the gathering darkness rendered all observation useless, can now detect it just before sunrise, and keep it in the field as long as may be wished, in the broad daylight, which is undoubtedly the only time when anything can be made of this difficult object. On April 2, the air being fine, and passably steady, I made a daylight observation of the planet. Three features were particularly noticeable:—Firstly, the decided blunting of the S. horn, which was very obvious; and also the apparent irregularity in the sharp N. one. In moments of fine definition, this N. horn appeared divided at its extremity by a dark line, making the extreme point like a bright speck detached from the other portion. Secondly, the excessive brightness of the limb of the planet, as compared with the portion from thence to the terminator. The limb, indeed, appeared as a very bright and distinct streak about 4″ in breadth, while the interior parts of the disc had a dull bluish hue. Thirdly, a very evident darkish spot, about two-thirds towards the N. horn, and upon the edge of the terminator. Its boundary, at the centre of the planet, was marked by a beautiful light streak springing from the terminator, while towards the N. the boundary was not defined, but gradually faded away into the general colour of the disc. The whole appearance of this beautiful marking reminded one of the dark plains in the moon, to which it bore an unmistakable resemblance."

Mr. John Birmingham writes:—"I saw Venus as the thinnest of cres-

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cents, at 11h. 30m. A.M., on Feb. 24, about 20 hours after conjunction. It would certainly have been visible *at* conjunction if the weather had been favourable."

The Planet Jupiter.

Mr. David Gill, jun., of Aberdeen, examined this object on March 5 with his 13 in. silvered glass reflector.* He obtained five measures of the equatorial diameter of the planet, and found the mean to amount to $36''\cdot95 \pm 0''\cdot05$. The amount of polar flattening was, therefore, equal to $\frac{1}{20\cdot8}$. Mr. Gill says:—"When measuring the planet I observed and noted that the E. limb was not so distinctly defined as the W., the latter being as hard and sharp as possible, while the other was shaded off. The true explanation of this did not occur to me until I had compared the measures of polar and equatorial diameter, when I found the difference to amount to $\frac{1}{20\cdot8}$ instead of $\frac{1}{18}$ to $\frac{1}{17}$, the generally received difference. It afterwards occurred to me that Jupiter was long past opposition, and the shading off of the E. limb was a phase of the planet, and that I had measured the amount of gibbosity. The result of the measures of the equatorial diameter somewhat exceeds that given in the *Nautical Almanack*. I presume this results from irradiation, which would disappear had a double image micrometer been employed, but this will not affect the result as to the differences between polar and equatorial diameter, as both diameters would be equally affected. The measures were made in daylight and strong twilight. No artificial illumination of the wires was required."

Measures of Double Stars.

Σ 1386. Mr. D. Gill writes:—"I detected this exquisite double star in the same field with nebula 81 M. Ursæ Majoris. I thought it new, but on referring to 'Webb' I found it to be Σ 1386, and suspected by him to be binary. I resolved to measure it, and did so the same evening (March 5), with the following result:—

Position (mean of 3 obs.) $= 291^\circ\ 21' \pm 7'$. Dist. (mean of 5 obs.) $2''\cdot45 \pm 0\cdot03$. The stars are very nearly, or exactly, of equal magnitude.

Struve gives in	1832—	Pos. 296° — ;	dist. 2″.	
Knott „	1864—	„ — — ;	„ 1″·6.	
Gill „	1870—	„ 291° 21′ ;	„ 2″·45.	

I therefore think there must be some mistake in Knott's measure of distance."

α Geminorum. (Castor.)

On March 4, Mr. D. Gill observed this star, and the following are the results of his measures:—Angle of position, $238^\circ\ 32' \pm 6'$; dist. $6''\cdot04$. "Only one measure of distance was made, when observations were interrupted."

Auroræ Borealis.

Mr. T. G. E. Elger of Bedford reports that faint auroræ were visible on the nights of the 28th and 30th of March. "The display on the 28th commenced at about 8h. 50m., and lasted till nearly 10h. 0m. Two or three white streamers, which nearly reached to the zenith, were seen in the north, but they were very faint and evanescent. No streamers were observed on the evening of the 30th, but the glow over the N. horizon was much brighter than on the 28th; the display took place between 8h. and 9h."

* The polar diameter was measured, and resulted in a mean of $35''\cdot20 \pm 0''\cdot05$.

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Mr. William Andrews, of Coventry, says:—"Auroræ have been often visible of late. The last observation was on April 5, at 11h. 50m., when several pale white streamers were seen rising vertically in the N.N.W. nearly to the zenith."

ORBITS OF JUPITER AND SATURN.—Mr. Breen's investigation of the corrections of Bouvard's elements of the orbits of Jupiter and Saturn has been made under the sanction and at the expense of the Royal Society, and has been printed as an appendix to the Greenwich Observations of 1868. The places of Jupiter and Saturn, as given in the *Nautical Almanack*, and the improved Berlin Ephemeris, are derived from the tables published by M. Bouvard in 1821, which were founded upon observations made at Greenwich and Paris from 1747 to 1814. From recent observations the errors of these places have been found to be very considerable, and a fresh investigation of the elements from the ancient observations was very desirable. The present work was undertaken for this purpose; it is brought out with great care, and occupies 80 printed pages. It was communicated to the Royal Society by Professor Stokes in December 1868, and read in March 1869.

THE ECLIPSE OF THE SUN—December 22, 1870.

The following is the notice issued to Fellows of the Astronomical Society with reference to this subject:—

"ROYAL ASTRONOMICAL SOCIETY,
"Somerset House, *April* 9, 1870.

"SIR,—We are instructed to communicate to you the following Resolution which was passed at a Committee of the Council held yesterday, April 8th:

"Resolved—'That the Fellows be informed that there is a possibility of the Government providing means of transit to and from stations on the Mediterranean for about sixty observers, who may be willing to take part in the Observation of the Total Eclipse of December 22, 1870; and that persons willing to undertake a portion of the Observation, on a plan to be arranged by the Council, be invited to send their names to the Secretaries, and also to state the branch of observation which they would be prepared, or prefer, to undertake, and the instruments they would be willing to contribute.'

"It is desirable that the names of those who are willing to take part in the observation of the Eclipse should be sent in, if possible, before the next Meeting of Council, May 13.

"We have the honour to remain, Sir, yours faithfully,

WILLIAM HUGGINS } *Hon. Secs.*"
E. J. STONE

NOTICES TO CORRESPONDENTS.

Sidereal Clock.—The number of vibrations in a complete sidereal day is 86,400.

Many communications are unavoidably postponed.

The Astronomical Register is intended to appear at the commencement of each month; the Subscription (including Postage) is fixed at **Three Shillings** per Quarter, *payable in advance*, by postage stamps or otherwise.

The pages of the *Astronomical Register* are open to all suitable communications. Letters, Articles for insertion, &c., must be sent to the Editor, Mr. S. GORTON, *Parnham House, Pembury Road, Clapton, N.E.*, **not later than the 15th of the month.**

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The Astronomical Register.

No. 90. JUNE. 1870.

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ROYAL ASTRONOMICAL SOCIETY.

Session 1869–70.

Seventh Meeting, May 13, 1870.

W. Lassell, Esq., F.R.S., *President*, in the chair.

Secretaries—Mr. Huggins, F.R.S., and Mr. Stone, F.R.S.

The Minutes of the last meeting were read and confirmed.

Thirty-seven presents were announced, and the thanks of the Society voted to the respective donors.

C. Gatty, Esq., E. Dent, Esq., and J. D. Perrins, Esq., were balloted for and duly elected Fellows of the Society.

The President said he was sure all present must have heard with extreme regret of the loss the Society had sustained in the death of Admiral Manners, who had filled successively the offices of Secretary, Foreign Secretary, and President,—his term in the latter position having only just expired. The Council had requested him to offer the expression of their sympathy and condolence to the widow, and he was certain the meeting would equally deplore the loss of their late President to science at a comparatively early age.

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The following papers were announced and such of them as time permitted, read :—

Chart of Sun Spots recorded in Mr. Carrington's Observations: by Sir John Herschel.

Professor Selwyn said that he had lately received from the author the drawing he handed round, with an explanatory letter which showed that Sir John, in the enjoyment of a green old age, still followed the bent of his early proclivities, and sought at all times to benefit astronomy. The map indicated the latitudes and longitudes of all the sun spots contained in Mr. Carrington's beautiful work between the years 1854 and 1861, and was made in order to ascertain whether there were any particular regions of macularity or spot frequency. There appeared, indeed, a kind of tendency to patches of spots, but by no means enough to lead to any decided result. The author had merely done this work for his own satisfaction, and had an affirmative tendency manifested itself he would have carried on the investigations with greater care; but rough as it is, it shows the non-existence of any special regions in longitude favored by spots. Professor Selwyn further remarked that, considering the great attention paid to sun-spots by Sir John Herschel, and that he was the first to suggest photographing them, and to point out that they were probably due to the same causes that produced cyclones, it was most interesting to find him thus engaged on the subject.

Professor Selwyn also exhibited a number of photographs showing the large spots, often visible to the naked eye, seen during March.

Mr. Proctor said that Mr. Kirkwood had indicated some such cause for the periodicity of sun spots as Sir J. Herschel had now disposed of. He could not help saying how much he was struck by the extreme courtesy of Sir J. Herschel, who was always ready to examine anything submitted to him, although in some cases the theory propounded might be at variance with his own views.

Occultation of Saturn by the Moon: by Mr. Talmage.

This occultation, on April 19th, was well seen at Mr. Barclay's observatory, Leytonstone. Saturn was visible to the naked eye to within $3\frac{1}{2}$ minutes of disappearance. The planet was of a yellow tint compared with the Moon's limb. The disappearance and re-appearance of Titan were observed. The eye-piece was half covered with silver foil to moderate the light. The times of first and last contact, disappearance, and reappearance were given, as already printed in the *Astronomical Register*. Power used 110, on a refractor of 10 inches aperture.

Occultation of Saturn: by Mr. Joynson.

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The phenomena were as well observed as could be expected. The times were given.

Occultation of Saturn: by Capt. Noble.

Besides reporting the times of the various contacts, disappearances, and reappearances of the rings and planet, the author dwelt on the physical features of Saturn, the planet being well and sharply defined. Ball's division was seen. Saturn was of a sickly greenish-yellow tint compared with the Moon.

Capt. Noble added that the occasion was most striking from the delicacy with which all the details of the planet's system were seen, and he was never more convinced of the absence of the slightest appreciable lunar atmosphere than on this night, when the crape ring was visible up to the very edge of the Moon's disc.

The Astronomer-Royal said that the same impression was made on the minds of the observers at Greenwich.

The President remarked that he believed the beauty of the sight might be explained by the Moon's light taking off all irradiation from Saturn, and leaving just enough light to allow everything to be seen without dazzle.

Occultations of Saturn and Stars by the Moon: by the Astronomer-Royal.

The details of contacts and disappearances and reappearances of Saturn and his rings were given as noted by three observers. Mr. Carpenter, who worked with the great equatorial, estimated that the light of the planet's surface was one-twentieth that of the Moon, and that there was no distortion at contact.

Observations at Coleby Field: by Mr. Penrose.

The objects observed were Algol, of which the minima were found to occur on Oct. 11, 1869, at 10h. 50m. G.M.T., and Dec. 18, 1869, at 6h. 7m. G.M.T., certainly within 10 minutes of the times noted. These observations show that the period, 2·86727 days, combined with the epoch, Jan. 3, 1844, given by Sir J. Herschel in his *Outlines of Astronomy*, requires a slight correction. The minima occurred nearly 3 hours earlier than the calculated times, and 2·867234 days would better represent the period. Occultations of Aldebaran and *m* Tauri were also recorded. The former star reappeared at the dark limb of the Moon on August 2, 1869, at 13h. 13m. 37s. and *m* Tauri on Feb. 10, 1870, disappeared at the dark limb at 9h. 7m. 19s. The occultation of Saturn was also observed. The two first occultations had been subjected to calculation, and it was found that Aldebaran would have given the longitude with an error of about 2″ and *m* Tauri within 13″. Several large sun spots have been observed, between 25 March and 25 April, which were very remarkable, especially with regard to their appearance when approaching the Sun's limb. If a spot is a cavity, one side of the penumbra should disappear as the spot

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approached the edge, but in this case it continued pretty equally visible on each side, showing how very obliquely the spot was situated with regard to the surface.

Mr. Browning had made many drawings of sun spots near the limb, and had sometimes seen the penumbra three times as wide on the side next the edge as on the other of a spot which before had the umbra in the middle

The Astronomer-Royal and Professor Selwyn both pointed out that this was exactly what should happen if the spots were cups or depressions.

Mr. Browning then drew a diagram, and showed that he had really meant the penumbra was visible on the inner side of the umbra.

Mr. Howlett could corroborate Mr. Browning, and state that in hundreds of cases of symmetrical spots, which on approaching the limb became foreshortened, he had seen the umbra still in the centre. He thought the photosphere must therefore be a mere varnish, and that it was rare to find a real cup-like depression. The illustrations of sun spots given in popular books were generally most absurd.

The Astronomer-Royal remarked that Mr. De la Rue had made an enormous collection of sun-spot pictures, which had been discussed at Kew, and 85 per cent. were in favour of the cavity theory.

Mr. De la Rue said that the frequent occurrence of the penumbra disappearing on one side near the limb showed a decided preponderance of evidence that the umbra was below the solar surface.

Mr. Howlett: Very slightly.

Mr. De la Rue: In some cases the depression is considerable. One spot gave a stereoscopic effect of depth by combining two pictures, and the faculæ were seen to be elevations. Unfortunately, these negatives had been accidentally destroyed, and it was rare to get pictures on each side of the meridian which could be used in this way.

Professor Selwyn would call Mr. Howlett's attention to the paper of Father Secchi, who estimated the depth of a spot to be one-third of the earth's radius, $\frac{4000}{3} = 1333$ miles.

Mr. Lockyer said: It hardly becomes me to refer to a method of observation which in time may become useful; but if any one will go over the recent spectroscopic observations of the Sun, he will see that it furnishes a method of determining whether a spot is a depression or not. Especially during the last year and a-half, I think there is such a change in the appearance of spots that we may assume, at least as a good working hypothesis, that the difference between the plane of the photosphere and the

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bottom of the spots is less at the maximum of spot frequency than at the minimum. This is based on the evidence of the amount of selective and general absorption found at such times, and which can be traced only to a difference in the thickness of the absorbing medium, and this means that a spot is a cavity.

The Astronomer-Royal desired to say how much he appreciated the steadiness of purpose with which Mr. Lockyer had pursued his observations, and hoped he would continue that course.

Meteorological Observations at Gibraltar : by Lieut. Browne.

In consequence of the discussion as to the climate of Gibraltar at the last meeting, the author had referred to his journals and other authorities for the amount of clear sky visible on the 22nd December, for the last 10 years, and tabulated the results. He found that on the day of the eclipse, in 4 years the weather had been very fine, in 3 very fair, in 3 doubtful, and only one really bad. Taking 17 days in each December, viz. from the 15th to the 31st, he found that two-thirds of them had fine blue sky, about 5 fair, and only one indifferent. The prospect of a fine day was therefore very satisfactory.

The President said that the Fellows might now be glad to hear something about the Eclipse Expedition, and he would therefore state that a large number of letters had been received from parties willing to proceed to the observing stations; that these had been referred to a committee of the Council, and after due consideration of their resources, an application would be made for Government assistance.

The Astronomer-Royal mentioned that he thought it desirable to state matters numerically as to the wants of the expedition. After a long and careful discussion in committee, it appeared that at each station there should be at least one general observer. Leaving these observations pretty much to his discretion, and coming to the classes of special observations which required the most attention, he found they had to deal with photography, spectrometry, and polarisation. There was no fear that this division would be disputed. To give good effect to these observations, it was estimated that 12 skilled persons would be wanted at each station, 3 of them being able photographers competent to adapt themselves and their processes to the circumstances of the case. They would require 2 assistants, one of whom ought to be a carpenter; and this was a more important matter than they might at first conceive, as the necessities for his labours would be numerous. The spectroscope had its peculiar wants; 5 skilled observers were required, 4 of them having 2 assistants each, and the other 1 only. How 5 such observers were to be found he knew not, but there was time to drill parties

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to the work. For polarisation it was indispensable that 3 persons should be engaged to observe the corona at different distances from the Moon's limb, and they might want 3 assistants, making at each station 12 skilled persons and 14 assistants, or 26 in all. He was informed that about 60 gentlemen had expressed a wish to take part in the observations, which would be about enough to fit out 2 stations, one at Xeres, near Cadiz, and one near Gibraltar. The next thing necessary was that the directors of the expedition should know what kind of work each man would undertake, and supposing too many desired the same occupation, what they would prefer next. He hoped that no one would be unwilling to change to any other kind of observation required, and thus assist in the general utility of the operations. It is indispensable that those who are entrusted with any department should have had the proper education for these observations. He (Mr. Airy) had been an observer for many years; he was not a photographer nor a spectroscopist, but he was a polariser, and thought he knew something about it. Lately, however, the observations recorded made him think he didn't understand it at all. Everyone who took up these observations should submit to an examination to afford proof that he knows what polarisation is—what is the plane of polarisation—and that he knows the plane when he sees it, otherwise it will be as bad as a clergyman not knowing the alphabet. As he (Mr. Airy) might have to bring the matter before the Government or the Royal Society, or this Society, for assistance, he felt it would not be right to do so unless he could say that each person was competent to do what he professed. The Council was most desirous of getting all the names of volunteers as soon as possible. The details were most laborious and troublesome, and they wanted to know at once what each person wished to do, that he would do anything else if necessary, and that he was able to do what he intended.

Mr. De la Rue wished to detain the meeting for a minute or two in order to observe that, Mr. Airy having shown the requirements as to the observers, he (Mr. De la Rue) desired to enforce upon them the necessity of starting early; they ought to secure as much time as possible to build observatories, to obtain the co-ordinates of their position, and to allow for the accidents which were sure to happen. No expedition ever set out with better prospects than this. In 1860 it was hardly known what had to be done; now, the exact things required were well ascertained. The expedition had excellent generals of division, and volunteers for the ranks, but wanted a commander-in-chief for its head; no one yet had appeared pre-eminently qualified for that position. He hoped these remarks might induce the Astronomer-Royal to send in his name, and this would then at once

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supply the required chief. In 1860 they had to depend on Mr. Airy for some of the actual work of observation; but he might, if he preferred, be released from any such detail now if he would take the general charge of the expedition.

The President: Everyone must concur in this suggestion.

Mr. De la Rue further stated that the work done was not likely to pass unrecorded, as the Poet-Laureate had signified his intention to join the party.

The Astronomer-Royal: The suggestion has already been made to me in committee that I should join the expedition as a sort of mild tyrant. However much flattered I may feel by the unanimous proposition, I cannot at present give it a definite answer; but I will most assuredly bear it in mind.

Professor Grant: Entertaining a pleasant recollection of the mild rule of the Astronomer-Royal in 1860, I sincerely hope that the wish expressed by Mr. De la Rue will be realised. One remark on the subject of the eclipse occurs to me, and that is, the general observers should include persons qualified to make sketches and drawings of the detail of the corona and prominences in addition to the classes of observation already referred to.

Mr. Stone: There are several gentlemen who will join the expedition for this express purpose. I may mention Mr. Brett and Mr. Bonomi.

On the Graphical Construction of the Umbral or Penumbral Curve at any instant during a Solar Eclipse: by Professor Cayley.

This paper had been already published in the *Monthly Notices*, but the author gave an oral explanation of his method, illustrated by a diagram.

The Astronomer-Royal desired to make an addition to his statement on the Eclipse Expedition. First, that the day of starting, supposing a steamer is granted, had been considered by the Council, and Saturday 3rd December fixed on; and, secondly, that if the enthusiasm on the subject should continue to increase, and more names come in, it would be very desirable to equip an expedition to the east coast of Sicily. This party must start earlier, and therefore names for it should be sent in without delay.

Mr. Huggins suggested the possible danger from brigands in this locality.

Mr. Howlett mentioned that it was as far again as Cadiz.

On the Proper Motion of 1830, *Groombridge*: by Mr. Lynn.

It having been shown by Argelander that this star has a proper motion larger than any other, and exceeding 5 seconds in amount, which estimate has been verified by other observers, it occurred to the author that the large number of observations made at the

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Royal Observatory, Greenwich, might be usefully examined to see whether the change was uniform. He had therefore discussed all the observations made from 1845 to 1869, and found, after allowing for precession, that the proper motion was constant and well established.

On the Resolvability of Star Groups regarded as a Test of Distance: by Mr. Proctor.

The author said that this paper might not be very interesting to many, but it discussed an important question, and divided it into two parts. The first related to groups of stars decidedly belonging to the sidereal system, and which were supposed to be part of the Galaxy extending to a greater distance than usual. Sir W. Herschel found such spots where he estimated the stars to be 2,000 times further from us than Sirius is. They must therefore produce spiked prominences extending far into space, away from the Sun. Now he (Mr. Proctor) did not believe in such prominences, because, if they existed in the Milky Way, he thought they would be elsewhere also; but nothing like them was to be found in the heavens. The difficulty was, that Sir William Herschel says so; but he should appeal to a greater astronomer, and a riper one, possessing much more experience. He meant Sir William Herschel himself in later years, for it could not be denied his views were more valuable in 1817 than in 1785, when he was only beginning his researches, and in the former year he says that the difficulty of resolution referred to may not be due to extension but to condensation. Popular works give only Sir W. Herschel's earlier views, but Grant's *History of Astronomy* leads us gradually on, and furnishes a perfect account of the great observer's results. The other point of the paper referred to small groups, evidently detached, which might be parts of our sidereal system or not, but were clearly separated from it. The question whether such a group, if removed to a great distance, would become a nebulous object, depends upon whether such stars go out from extreme distance, or whether they would become imperceptible before that distance is reached. In this case they would become nebulous to the same eye and telescope; but the question becomes complicated, as the object might become nebulous, and yet afterwards be again resolved by increased telescopic power. He therefore thought that the power required to resolve a group was no test of its distance. This had a bearing on the author's view that the Milky Way was a spiral. This was opposed to Sir John Herschel's view, but Mr. Proctor quoted Sir J. Herschel's statement that in the minor Magellanic cloud the border was always irresolvable, but the heart always resolved. If the constitution were uniform the body should be more difficult than the border, but as there is a difference in the

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same object, therefore the constitution must differ in parts, and the nebulosity is not a proof of increased distance.

Mr. Stone: I think that Mr. Proctor has been rather too hard on the theory of distribution according to uniform distances. While I am not prepared to accept implicitly Struve's hypothesis I cannot help seeing that there is a general order in this matter. We know that light decreases as the square of the distance increases; we know as a fact the parallax of some of the stars from the 1st to the 8th magnitudes. This does not close the range of our vision, but only our means of measuring. I think that, looking to the great increase of stars seen as the aperture is increased, that the idea of the general distribution of stars in space accounts satisfactorily for the fact. It is no disproof of this to show that there are first-magnitude stars further off than smaller ones, provided an average be taken. Nothing militates against this view that, on the average, magnitude depends on distance and not on the intrinsic brightness of the star.

Mr. Proctor: I agree thoroughly in what Mr. Stone has said, but I believe that there is not an absolute uniformity but a variety indicating progress. In organic nature we find this very remarkable, and I think that in the starry heavens, the greatest of God's works, the same variety and progress are to be found.

Mr. Stone: The assumption of uniformity is made for the purposes of reasoning and calculation, but I have already stated there are certainly exceptions, and it is not intended to say it is true to the extreme.

Mr. Proctor: I am sure Sir J. Herschel does not intend that it should; but it is generally accepted that, if you take one spot, you ought to find others like it.

Mr. Stone: I believe there may be clusters giving evidence of condensation, but yet there is a general uniformity. The Milky Way itself is an aggregation of such clusters.

Mr. Proctor: If we get a cluster of a definite form we know we are outside of it, but if we are inside, our position is not so clear. This makes the difficulty with the Milky Way.

The discussion was carried further by the aid of diagrams, without which the remarks would not be intelligible.

On an early Telescope made by Guiseppe Campani of Rome: by Mr. Williams.

At the sale of Dr. Lee's instruments Mr. Williams purchased the telescope exhibited to the meeting, and thinking it a matter of interest to the Fellows, had drawn up the account which he presented to the Society. The telescope was made by Campani, who was reputed to be the best optician of his time, and was employed by Cassini to construct the glasses with which he made his discoveries, including several satellites of Saturn. There is

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no biography of Campani, but he lived about the middle of the 17th century, and constructed telescopes of 20 and 50 feet long. The one before the meeting is about 10 feet long, and is mentioned by Smyth in the *Speculum Hartwellianæ*. The aperture is 2 inches, reduced by stops to 1½ inch. The object-glass is good, and the eye-piece contains 3 plano-convex lenses. The tube is of vellum, very light, only 2 lbs. 11 oz. in weight, but troublesome from its length and flexure. It can be shut up to about 2 feet in length. Instructions for use, in Italian, are engraved on the eye-piece. When purchased it was dirty and in bad order, but now, when cleaned and tried on a distant board of letters, it has good definition and a flat field. The craters of the Moon and the ragged edge are very well seen. The power is 20, or rather less. It is, therefore, an interesting specimen of the instruments with which astronomers worked 200 years ago. Mr. Williams also exhibited several other ancient telescopes, 12 or 13 feet long; one of 6½ feet, and a small one. These were of English make and not nearly equal to the Italian, except the small one, which, compared with a little travelling telescope by Ross, differed only in power and colour. Of course, the whole were not achromatic and showed much colour.

Mr. Huggins said he had looked at the word (Admiralty) across the quadrangle of Somerset House, which was well defined. The power was certainly quite 20.

Mr. Prideaux enquired whether all the telescopes came from Dr. Lee's.

Mr. Williams: Only the Campani one.

The instruments were examined by several Fellows after the meeting. The Moon was very clearly defined, but the colour was strong except in the middle of the field.

On the Photographs taken during the total Solar Eclipse of Aug. 7, 1869: by Commander Ashe.

Further remarks on η Argus and the surrounding Nebula: by Mr. Abbott.

On the determination whether the Corona is a Terrestrial or Solar Phenomenon: by Mr. Seabrooke.

On Jupiter's Satellites: by Mr. Severn.

On the Radcliffe Catalogue: by Dr. Wolfer.

Remarks on Dr. Wolfer's Paper: by Mr. Stone.

Note respecting η Argus: by Mr. Severn.

Note respecting the Corona in Solar Eclipses: by P. Secchi.

Loi du movément de Rotation des Planetes: by M. Flammarion.

The meeting adjourned at a late hour.

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CORRESPONDENCE.

N.B.—We do not hold ourselves answerable for any opinions expressed by our correspondents.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

THE EYE-PIECE FOR CORRECTION OF CHROMATIC DISPERSION.

Sir,—In reply to the enquiry of your correspondent "G. J. W.," in the last issue of the *Astronomical Register*, I can state that the eye-piece intended for correction of atmospheric chromatic dispersion is constructed by Mr. Simms, by Mr. Browning, and possibly by other opticians, as the construction is simple.

I am, Sir, your obedient servant,
G. B. AIRY.

Royal Observatory, Greenwich,
London, S.E.:
May 6, 1870.

OBSERVATIONS FOR LATITUDE AND LONGITUDE.

Sir,—In the number of the *Register* for April, your correspondent "T. G. R." makes the suggestion that the position of the several private observatories should be given in these pages. I hope, therefore, the following account of my attempts to approximate to my latitude and longitude, in the absence of costly instrumental appliances, may not be without a certain interest to some of your readers. The Ordnance maps, on the scale of an inch to a mile, by the latitudes and longitudes marked on their margins, enable the amateur at once to approximate to his position with an accuracy and ease quite unattainable a few years ago. By dotting down the position of my own little "gazebo" on the Ordnance map, there resulted, longitude $7^m\ 43{\cdot}0^s$ W., latitude $52°\ 28'\ 13''$ N. I confirmed the longitude, in April of last year, by a direct comparison with Greenwich Observatory, under very favourable circumstances, so that I look upon it as certain, probably to within a quarter of a second. I observed the occultation of δ Arietis in January 27, 1863, and the resulting longitude most carefully calculated was $7^m\ 44{\cdot}9^s$. Again, on April 23, 1864, I observed the occultation of λ Libræ, and obtained a second longitude, $7^m\ 47{\cdot}5^s$. The mean of these is $7^m\ 46{\cdot}2^s$, placing me $3{\cdot}2^s$ farther west than the Ordnance map. According to Table XII. in Loomis's "Practical Astronomy," $1''$ of parallel at latitude $52°\ 28' = 61{\cdot}93$ feet, and consequently $1^s = 928{\cdot}95$ feet, and $3{\cdot}2^s = 2972{\cdot}64$ feet, or 991 yards nearly. This is, I presume, a tolerable result from only two occultations. In the number of the Monthly Notices for January last, an observation of the disappearance of ξ^2 Ceti is recorded by Capt. W. Noble, who remarks as follows:—"Our Fellow, Mr. F. C. Penrose, has now most kindly and obligingly computed my longitude from the above disappearance, and finds that had such longitude depended upon this single observation, 'it would have involved an error of only about 1,300 yards.' I hope though to refine upon this considerably." The calculations have been made after the example given in that admirable work, invaluable to the amateur, Inman's "Navigation and Nautical Astronomy," in which the whole subject of the calculation of longitude from an occultation is treated with remarkable clearness. The formula there employed is that proposed by Sir Thomas

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Maclear, in the fourth volume of the Memoirs of the Royal Astronomical Society.

As regards the latitude, I have a very beautiful little sextant of four inches radius, made for me by Mr. Simms, which, with its stand, packs up in a small box not more than 8½ inches long. This, on two occasions, I have employed, with a mercurial horizon, to observe the latitude with stars.

On May 24, 1864, 13 altitudes of Arcturus, treated by the method of circummeridian altitudes, and 9 altitudes of Polaris, by the formula in the preface to the "Nautical Almanac," gave as a mean result 52° 28′ 21·7″ N. On April 4, of this year, 17 altitudes of Regulus, combined with 13 altitudes of Polaris, produced a mean result, 52° 28′ 23·0″ N., or mean latitude from the two series, 52° 28′ 22·3″. This is 9·3″ farther north than the Ordnance map, or about 313 yards, which, supposing the Ordnance map to be absolutely correct, which, I presume, is open to doubt, is perhaps as near as can be expected from so small an instrument. The nights, on both these occasions, were so calm, that I was enabled to dispense with glass roof to the mercury. I may mention that, throughout these observations, I depended on my own time, obtained by careful transits with a 30-inch transit instrument of 2¼-inch aperture, by Troughton & Simms, and a fine clock and pocket chronometer, both by Mr. Charles Frodsham. I hope to prosecute this interesting subject further.

I am, Sir, yours obediently,

Chad Road, Edgbaston, Birmingham: GEORGE HUNT.

May 5, 1870.

P.S.—For the present, until I can get further observations for latitude, I consider my position to be—lon. 7^m 43·0^s W., lat. 52° 28′ 22·0″ N.

THE OCCULTATION OF O^2 LIBRÆ.

Sir,—We were told by the *Nautical Almanac* that on Saturday, the 14th of this present month, there was to be an occultation by the moon of O^2 Libræ, at 11h. 29m. G.M.T., but on seating myself at my telescope (a 6-foot equatorial, by Cooke), some ten minutes before the phenomenon was due to come off, I was surprised to find *no star* at all near which could be occulted at all! I thought it just possible that a printer's mistake might have put O^2 for A^2, but on turning to A^2 Libræ I found it a good way west of the moon. *That* therefore was not the solution. Then I thought it possible that as O^2 is only a 6th mag., my view might have been *intercepted* by a bad atmosphere, and I determined to wait for the reappearance; but no O^2; and finally the conclusive part of the matter is that, on referring to a good map (the large one of the Useful Knowledge Society), and comparing the place of the moon at that time with the R. A. and Dec. of the star, I saw that it *could not* have been occulted. On comparing notes with a friend, who is also an amateur observer at Reading, I found his experience had confirmed mine.

Unless, therefore, we are both very much deceived, the *Nautical Almanac* is wrong.

If you think fit to insert this letter in your next No. of the *Astronomical Register*, some of your better informed correspondents may have something to say on the point.

I am, yours faithfully,

Mortimer Vicarage, Reading: R. G. GOULD.

Friday, May 20.

P.S.—With reference to the occultation, you will observe that by the

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Nautical Almanac on Saturday the 14th inst., at 11.29 G.M.T., the moon would be 13.28 S. Dec. Now, O^2 Libræ is 14.40 S. D. An occultation, therefore, was *simply impossible*. *But* we ought to *have seen* the star very near the moon's limb.

SPOTS ON PLATO.

Sir,—May I ask for a small space in which to enumerate the following results of twelve months' observations of the spots on Plato.

1st. Since 1820 thirty-five spots have been detected on the floor of Plato. They have all been seen between 1869, April 21, and 1870, March 23, but not simultaneously.

2nd. The greatest number that has been seen on any one evening is 22, and the smallest number 1.

3rd. The mean number visible on any evening is 7. The same spots are not visible from evening to evening.

4th. On twelve evenings on which the maximum numbers were observed in each lunation, the largest number was 22, the smallest 4, and the mean 12.

5th. The mean angular distance of the moon and sun, or ☾ — ☉, which corresponds with the mean of the several maxima, is 159° or 21° less than opposition.

6th. In the absence of a discussion in reference to solar altitudes and azimuths, it may be noticed, that in 10 out of every 12 cases the maximum number of spots occurred before "full," and therefore before the sun attained his meridian altitude at Plato.

Should the observations be continued another year, a comparison of the results with those now obtained will be important.

Observatory,
Cynthia Villa, Walthamstow,
April 6, 1870.

I am, Sir, your obedient servant,
W. R. BIRT.

DIALYTE TELESCOPE CONSTRUCTION.

Sir,—I notice a few enquiries about "dialyte" telescopes, and as I have a little experience in the matter I may be able to furnish a little useful information on it.

About 2½ years ago I conceived the idea of correcting the secondary spectrum on this plan, and after much pains obtained the curves required to do it. I found that the correcting compound lens must be one-third of the focus from the O G, and all its curves according; thus the first surface of the O G shall be = a, then the back surface must receive the rays vertically (this corrects the spherical aberration); this is found by dividing the refracting index (for crown about 1·53) by its excess above 1· = 2·88, which, for my own purposes, I call the "focal exponent." Then a × 2·88 = radius for surface 2; the outer surfaces of the correcting lens should, theoretically, be two-thirds of that of the back surface of the O G; but the last surface, or the one next the eye, should be a long radius, or else it will act too much as a concave, and throw the focus out too much. This is a practical necessity, perhaps a plane would answer well; then the almost touching surfaces between flint and crown (the correcting surface) was three-fifths of the radius of the front surface of the O G. This I found, after two alterations, to correct most completely the secondary spectrum, for I began with it at ·75 of the front radius of the O G, ending at ·6.

The correction for secondary spectrum was very imperfect, indeed the

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image was pure white, but there was a bright whitish halo both before and behind the focussing point on a brilliant object, brighter than in a good slightly over-corrected O G of the common construction. Beyond this, however, the task of centering and figuring of the six consecutive surfaces was simply herculean. It may be imagined when I state that, after getting all my curves right and putting on a polish, I had it off and on the machine for trial *no less than* 150 *times*. It was a very fine piece of work when done, 6⅛ in. aperture and 120 in. focus. You could always see the image spoil if you moved the eye-piece one-thirtieth of an inch; but for all that, I condemned it on the very day I finished it. This was the construction I proposed in a paper I read at the R.A.S., just about two years ago, when Mr. Stone said that it would only correct for three points, and I did not think that more was likely to be wanted; but I know better now, for since then I have tried a still more refined plan, which I cannot here detail, but will say that it was by a lens made of *two kinds of flint glass*, placed at the inner end of the eye-tube of an ordinary achromatic; but this, although right in plan, did not get quantity enough, and I abandoned it. I will, some time, send a detailed account of this, and of the enquiry into the secondary spectrum which led to it.

So I now believe that our only refuge will be in "rational" glass (when obtained).

I have never seen or tried the dialyte in which the whole primary spectrum is corrected near the eye-piece. Doubtless it may do good work, but as the secondary spectrum is so distorted and amplified, it would not come up to my mark. It would, however, give a nice steady image, if the correcting lens is a fine one, on account of having only two refracting surfaces in the O G. I am, Sir, yours, &c.

London: April, 1870. A. DAWSON.

P.S.—The curves for a dialyte lens should be somewhat as follows:—For a 4 or 5 inch O G, 5 feet focus, diameter about 2½ inches, radius next the eye-piece (concave) equal to its distance from the eye, say 15 inches; middle or acting surfaces about 10 inches, or perhaps as short as 8 inches (nearly in contact and practically equal); front surface, next O G, would come about 10 inches; it should be made so that the compound neither magnifies nor diminishes, all the needful altering being done on the front surface only. You then slide it up and down, to obtain any degree or quality of achrometism you may prefer. The flint glass about 3·6 density, and placed next the eye.

ASTRO-METEOROLOGY.

Sir,—"The Hackney Scientific Association" may or may not be destined to become a scientific power in the State, and Mr. H. W. Emons may be thoroughly justified in occupying something like a page of the *Astronomical Register* with an account of its doings; but I must protest against the intrusion of Mr. Pratt's nonsense into your columns, in connection with the dictum that "past experience assures us of the correctness of his results." Mr. Pratt's "science" (Heaven save the mark!) is a mere reflex of that of the late Mr. White, and the present fortune-teller, Zadkiel, and is a simple claim to be able to prophesy what atmospheric changes will take place, from the Astrological "aspects" of the planets; "Jupiter in trine," "Venus in sextile," "Uranus in quadrature," *et id genus omne*. Now, as long as a man confines himself to vague generalities he may usually evade the responsibility of his assertions; but when he pledges himself to a distinct

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piece of vaticination, he supplies a test from which subsequent events deprive him of a chance of receding. Unluckily for himself, this Mr. Pratt has been weak-minded enough to do; and with the result of the most dismal and ignominious failure.

There is (or was, for I am uncertain if it be still in existence) a publication called the *British and Foreign Mechanic*, and in the fifth number of this, which came out last October, Mr. Pratt had the hardihood to predict that the last ten days of that month would be "genial," owing to the "mild dry influence of Mars." I will not say one syllable further than to beg anyone who keeps a meteorological register to turn back to it and see how this prophecy was fulfilled. It is very certain that anyone who will take the trouble to do this, will assuredly not find that past experience assures him of the correctness of Mr. Pratt's results.

The sort of trash put forth under the title of "The Planetary Origin of Weather Changes," may suit the servant-girls and others who form the immense shoal of illiterate patrons of *Zadkiel's Almanac*, but I would certainly submit that even a mere reference to it is wholly out of place in the columns of a strictly scientific serial like the *Astronomical Register*.

I am, Sir, truly yours,
EMPIRICI OSOR.

[The *Hackney Scientific Association*, commencing in our immediate neighbourhood, and numbering among its supporters many of our subscribers (Mr. Lynn, Mr. Birt, &c., see p. 227, vol. VII.), and giving much attention to astronomical matters, it was natural that we should take some notice of it; we regretted, however, that Mr. Emons should have expressed approval of Mr. Pratt's papers, some of which he sent us, but we did not insert them. The institution is at present young; we hope as it gains in years it will gain in wisdom, so as to be enabled to discriminate between pure science and what (in opposite meaning to the words of a great *philosophical* society) is falsely so called. We have received an abstract of the report of the third annual meeting, from which it appears that the society is progressing satisfactorily.

As to the *British and Foreign Mechanic*, that publication, and the *English Mechanic*, from which it emanated, are both in existence; their columns are open to any amount of correspondence on scientific subjects, good, bad, and indifferent; and letters on astronomy, correct and stupid, clever and ignorant, are mixed up in a happy jumble with communications on sewing-machines, spiritualism, harmonium reeds, bicycles, big heads, biology, and matrimony; these indeed appear in such profusion that, as is evident, they cannot undergo editorial supervision: as instances, let our readers who see these papers, refer to the letter on "Solar Incandescence," *B. and F. Mechanic*, p. 74, No. 29; or to that on the "Figure and Motions of the Earth," p. 89, No. 264, of the *English Mechanic*. These letters must certainly have got into the publications without the knowledge of the respective editors.]

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D'ARREST'S COMET.

Sir,—The following ephemeris of this body for the month of June will be useful to some of your readers:—

Berlin Mean Moon.

1870.		R.A. h.	m.	s.		N.P.D. °	′
June 1	...	15	49	17	...	76	36
3	...	15	47	19	...	76	28
5	...	15	45	21	...	76	22
7	...	15	43	26	...	76	18
9	...	15	41	34	...	76	17
11	...	15	39	45	...	76	17
13	...	15	38	0	...	76	20
15	...	15	36	20	...	76	24
17	...	15	34	46	...	76	31
19	...	15	33	18	...	76	41
21	...	15	31	56	...	76	52
23	...	15	30	43	...	77	5
25	...	15	29	37	...	77	21
27	...	15	28	40	...	77	39
29	...	15	27	52	...	77	59

I remain, your obedient servant,

Windyhills Observatory, Bickley: G. F. CHAMBERS.
May 2, 1870.

PERIODIC METEORS.

Sir,—In a paper read before the American Philosophical Society, November 19th, 1869, it was stated by the writer that the August meteors had probably entered the solar system not long previous to the year 800. This statement was based solely upon the fact that while they have been very often subsequently observed, their first recorded appearance occurred in the year 811. Further consideration, however, has shown this conjecture to be probably erroneous. The extensive diffusion of meteors along the orbit, as manifested by the frequent showers from 811 to 841, seems incompatible with the theory of their then recent entrance into our system. It is believed, however, that existing data afford evident traces of the ring's ancient history. On this point the following facts seem worthy of notice:—

(1.) The returns of the shower of August 10th during the last 90 years demonstrate the ring to be now nearly, if not quite, continuous.

(2.) A comparison of the dates at which the shower has appeared, indicates, as has been observed by Schiaparelli, that the period of the meteors is somewhat less than that of Tuttle's comet (1862 III.)

(3.) The long interval (83 years) between the last observed shower in the 9th century and the first in the 10th, proves the existence of a wide chasm in the ring no more than 1000 years since.

(4.) Tuttle's comet and the August meteors formed a cometary system before entering the solar domain and doubtless made their *first* perihelion passage at nearly the same epoch.

Yours truly,

Indiana University, DANIEL KIRKWOOD.
Bloomington, Indiana, U.S.A.,
13th April, 1870.

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4½-INCH REFLECTORS.—In the April number, a correspondent gives an account of the performance of a telescope of 4½ inches aperture, which, being one of the sizes of Browning's silvered glass Newtonians, I imagined at first related to one of those instruments, till the mention of the object-glass showed an achromatic was referred to. How is it that no one ever gives a description of the performance of these 4½-inch specula? There must now be many of that size in different hands, but though the possessors of large mirrors, and the owners of refractors of all sizes, are constantly publishing their experience, the smaller reflectors (though stated to do good work) seem to lack reporters.—G. G.

DOUBLE STAR ORBITS.—Some one who has access to the 5th vol. of the Memoirs of the R. A. S. might extract from it Sir John Herschel's method of obtaining an approximate orbit by graphical construction, which might be acceptable to some of the readers of the *Astronomical Register*, should there be space for it. Mr. Waller's trial, as he observes himself, only gives the *apparent* ellipse, or orthographical projections of the true orbit on a plane perpendicular to the line from the spectator to the star.—G. J. W.

THE PLANETS FOR JUNE.

AT TRANSIT OVER THE MERIDIAN OF GREENWICH.

Planets	Date	Right Ascension	Declination	Diameter	Meridian Passage
		h m s	° ′		h m
Mercury	1st	4 58 22	+20 51	12″·1	0 19·2
	15th	4 34 22	17 35½	10″·6	22 56·3
Venus	1st	1 46 14	+ 8 33½	18″·1	21 3·7
	15th	2 46 10	13 34½	16″·2	21 8·4
Saturn	1st	17 44 3	—22 7	16″·6	13 2·9
	15th	17 39 41	22 6	16″·6	12 3·5

On the 4th of the month **Mercury** passes the meridian twice; at one minute past noon, and at five minutes before noon on the 5th. The inferior conjunction takes place about six o'clock in the evening of the 4th. The planet is then about 2½ degrees below the sun. At the end of the month Mercury passes the meridian about an hour and a half before noon, and is then at its greatest westerly elongation, and in the most favourable position for observation in the mornings.

Venus may be observed in the month of June much in the same manner as last month, passing the meridian at the beginning just after 9 o'clock in the morning, and about a quarter past 9 at the end of the month. The diameter of the planet is, of course, decreasing.

Saturn arrives at opposition this month, and may therefore be as well observed as the low altitude of the planet will permit. The meridian passage takes place about 1 o'clock in the morning at the beginning of June, and about 11 o'clock in the evening at the end of the month.

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ASTRONOMICAL OCCURRENCES FOR JUNE 1870.

DATE		Principal Occurrences		Jupiter's Satellites		Meridian Passage
		h. m.			h. m. s.	h. m. Saturn
Wed	1	17 19	Sidereal Time at Mean Noon, 4 39 4·2 Conjunction of Venus and o Piscium, 7m. ·0 W.			13 2·9
Thur	2	5 41	Conjunction of Moon and Uranus, 0° 26′ N.			12 58·6
Fri	3		Meridian Passage of the Sun, 2m. 11s. before Mean Noon			12 54·4
Sat	4	6 3	Inferior Conjunction of Mercury			Moon 4 21·2
Sun	5					5 13·0
Mon	6	11 16	☽ Moon's First Quarter			6 3·9
Tues	7					6 54·4
Wed	8					7 45·1
Thur	9					8 36·9
Fri	10					9 30·7
Sat	11	9 43 9 51	Occultation of θ Libræ (4½) Reappearance of ditto			10 27·0
Sun	12					11 25·8
Mon	13	1 47 6 59 11 55 12 38	○ Full Moon Conjunction of Moon and Saturn, 0° 51′ S. Occultation of B.A.C. 6088 (6) Reappearance of ditto			12 26·1
Tues	14					13 26·3
Wed	15		Illuminated portion of disk of Venus = 0·681 of Mars = 0·985			14 24·5

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DATE		Principal Occurrences		Jupiter's Satellites		Meridian Passage
		h. m.			h. m. s.	h. m. Saturn
Thur	16	4 5 12 50 13 58	Sidereal Time at Mean Noon, 5 38 12·5 Opposition of Saturn Occultation of η Capricorni (5½) Reappearance of ditto			11 59·2
Fri	17		Saturn's Ring: Major Axis = 41″·5 Minor Axis = 18″·6			11 54·9
Sat	18					11 50·7
Sun	19		Meridian passage of the Sun, 58s. after Mean Noon			11 46·4
Mon	20	9 34	☾ Moon's Last Quarter			11 42·2
Tues	21					11 38·0
Wed	22			2nd Sh. E. „ Tr. E.	14 35 15 36	11 33·7
Thur	23			1st Sh. I. „ Tr. I.	14 29 14 59	11 29·5
Fri	24	21 35	Conjunction of Moon and Venus, 2° 11′ N.	1st Oc. R.	14 32	11 25·2
Sat	25			3rd Sh. I.	15 29	11 21·0
Sun	26	8 22 9 3 14 19	Conjunction of Moon and Mars, 3° 27′ N. Conjunction of Moon and Jupiter, 2° 42′ N. Conjunction of Moon and Mercury, 0° 28′ S.			11 16·7
Mon	27	1 12	Conjunction of Jupiter and Mars, 0° 44′ N.			11 12·5
Tues	28	11 33 20 5	● New Moon Eclipse of the Sun, invisible at Greenwich Greatest Westerly elongation of Mercury 21° 40′			11 8·3
Wed	29	14 43	Conjunction of Moon and Uranus, 0° 16′ N.	2nd Sh. I.	14 41	11 4·0
Thur	30					10 59·8
Fri July	1					10 55·5

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SPECTROSCOPE CONSTRUCTION.—Will "W. P." kindly inform me the name of the well-known weekly journal to which he refers in his letter on spectroscope construction, which appeared in your April number?—A. MOBERLEY.

[We presume either the *British and Foreign* or the *English Mechanic* is the publication referred to.—ED.]

DRIVING CLOCKS.—Can anyone of your readers supply me with the name of any skilled artificer who can and will furnish (and at a reasonable rate) an efficient driving clock to an achromatic telescope of six inches aperture, mounted equatorially on the English plan; and who will not be *above* the task of adapting it to a mounting already made under an amateur's own eye, and already possessing an hour-circle with toothed edge and tangent screw? It must be of *ample power*, as several clocks which I have seen have not only been very expensive, but deficient in power. —A. K. C.

[We once saw a very efficient driving clock which could be applied to any telescope, at Mr. Slater's, in the Euston Road; it was rough but powerful. We understand a new, effective, and cheap driving apparatus, applicable to equatorial telescopes of all descriptions, the invention of Mr. F. Bird, of Birmingham, will shortly be announced in our columns.—ED.]

ASTRONOMICAL REGISTER—Subscriptions received by the Editor.

To March 1870.
Forward, R.

To April 1870.
Barkas, T. P.

To June 1870.
Elliott, R.
Metcalf, Rev. W. R.

To July 1870.
Lewis, H. K.

To September 1870.
Guyon, G.

To December 1870.
Adams, S.
Banks, W. L.
Dobie, Dr.
Felkin, W.
Weldon, Mrs.

To December 1871.
Gould, Rev. R. J.

May 24, 1870. Subscriptions received after this date in our next.

Subscriptions received by J. D. Potter, 31 Poultry, London.

To June.
Rickett, John
Lassell, William
Scully, Thomas
Chevalier, Rev. Temple
Bedford, Edwin J.

To September.
Dunn, G.

To December.
Rodriquez de Capeda
Michell, H.
Royal Observatory, Melbourne
Crossley, Edward
Simpkin & Co.
Noble, T. S.
Stevens, B. F.
Penrose, F. C.
Vanner, W.
Gatty, C. H.
Macnaghten, Lt.-Col.
Brown, T. O.
Mann, Henry

NOTICE TO CORRESPONDENTS.

We have again to defer several interesting communications.

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THE OBSERVING ASTRONOMICAL SOCIETY.

Hon. Sec. WILLIAM F. DENNING, Ashley Road, Bristol.

REPORT OF OBSERVATIONS MADE DURING THE PERIOD FROM APRIL 7 TO MAY 6 INCLUSIVE.

Occultation of Saturn.

Mr. George J. Walker writes:—"I had a fair view of the occultation of Saturn this morning (April 20), notwithstanding the prevalence of clouds. The following were the times, which I think are reliable to within a second, excepting the third, which was less favourably obtained, as the moon almost immediately afterwards disappeared behind a chimney:—

	h.	m.	s.	
Contact of planet's ring with moon's bright limb	14	49	45·2	G.M.T.
Bisection of planet and ring	14	50	23·2	"
Disappearance of the planet and ring . . .	14	51	3·2	"

Telescope 3¾-in. O.G., power 175.

I could not, owing to the obstruction of houses, reach the moon at the time of re-appearance with my telescope, and the increase of clouds seemed to preclude hope of seeing it at all. However, I watched for it with my sweeper, and a fortunate break in the clouds showed me the planet, which I conclude, from its brightness, was completely uncovered at 16h. 1m. 2·2s., after which it was again overclouded. I cannot, therefore, be sure that the planet had not re-appeared before, but I am inclined to believe the above is very nearly the time of its re-appearance. The planet, owing to cloud and the greater brightness of the moon, looked a very dingy, leaden kind of colour, as the moon approached it."

Mr. W. Andrews, of Coventry, says:—"The occultation of Saturn was observed by me on the morning of April 20. The atmosphere was not very tranquil, and the definition not good. The division between the rings was visible; also faint traces of belts on the body of the planet. The planet appeared of a pale ashy gray colour, when contrasted with the bright creamy colour of the moon. Not the slightest distortion or any change whatever was observed in the appearance of the planet as it disappeared behind the moon."

At other places, the weather seems to have been unfavourable for the observation of the phenomenon.

Auroræ Borealis.

Mr. H. M. Whitley, of Penarth, Truro, reports that—"On April 5, at 8h. 15m., a rosy streak stretched from the horizon nearly to the zenith. It was brightest and broadest near Polaris—arc of faint white light below. At 8h. 30m. three streaks were visible, the one mentioned, and two others much fainter, which faded away and re-appeared at other parts."

The Rev. S. J. Johnson writes:—"On the 21st of April I observed another exhibition of the aurora. It first became visible between 10h. and 11h. P.M. It reached from beneath Castor and Pollux right round to Vega. The brightest part was always from below Capella to Cassiopeia. There was a line of black clouds along the horizon. I noticed one meteor cross the aurora, and shortly afterwards another small meteor appeared in Leo Minor. Though the brightness of the aurora was considerable, the

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streamers that shot upwards were faint and few. I saw none of the rosy tint. At 11h. 30m. the sky became overcast with haze; when this cleared off, about 11h. 50m., the phenomenon appeared to be nearly gone. On the 27th of April I saw another bright display, between 11h. and 12h. The sky was not so clear as on the former night. In some parts of the north, where there were large breaks in the clouds, the phenomenon was very conspicuous. There was a strong tinge of it again the following night, especially in the N.W."

Meteors.

The Rev. S. J. Johnson observed several bright meteors on the 18th and 20th of April. At 11h. 15m. on the 18th he "saw a very bright meteor below Ursa Major. It started from near β Leonis, and disappeared a few degrees S. of σ Leonis. Its colour, so far as I could judge, was peculiar—a kind of reddish white, and the time of its duration was very short. It left a momentary train. A minute or two afterwards, I noticed a moderately bright meteor, which nearly passed over Pollux. I saw no meteors on the 19th; two on the 20th, in the north of Virgo, almost simultaneously."

Mr. Albert P. Holden says:—"A bright meteor was well seen about midnight on May 2nd. The course was from ϵ Cygni towards β Herculis, passing about 5° below β and γ Lyræ. It was without train of any kind, and remained in view about 4 seconds."

Solar Spots.

Mr. T. W. Backhouse reports:—"That the large group of spots in the N. hemisphere of the sun, which was visible from about April 4th to the 16th, was due on this side of the disc on April 30, but only a small spot with a large group of faculæ appeared then, so that if it was the same group it had diminished remarkably during the fortnight it was out of sight, for its penumbra was but 4,000 miles in diameter on May 2 at 4h. On May 2 there appeared a larger group of spots in the same solar latitude as the large group referred to had, but as it was two days after it was due, it seems hardly possible that this can be the same. On May 4, at 3h. 30m., its largest penumbra was 18,000 miles in diameter, and umbra 7,000 miles in a direction parallel with the limb. It has not altered greatly in size since."

The Planet Uranus.

Mr. H. Michell Whitley observed this object on April 5. The disc of the planet was of a pale light blue colour, with no markings on it.

Epsilon Bootis.

Mr. Albert P. Holden writes:—"Two comites to this exquisite pair do not appear to have been remarked till lately. I roughly estimated them as follows:—

b. Pos. 40° Dist. 35″ Mag. 10.
c. Pos. 120° Dist. 60″ Mag. 10½.

These particulars being taken without a micrometer are, of course, only approximate."

Lunar Observations.

Observations of lunar objects by Messrs. H. M. Whitley and H. Ormesher have been forwarded to Mr. W. R. Birt.

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MR. PROCTOR'S NEW WORK.

OTHER WORLDS THAN OURS.—By R. A. PROCTOR, B.A., F.R.A.S., London, Longmans.—As a new serial by Dickens or a new novel by Disraeli is welcome to the general public, so a new work from Mr. Proctor's pen is hailed by all interested in our favourite science. Mr. Proctor's subject is most interesting, and he has produced a very readable book, which will prove attractive to scientific and non-scientific readers alike. Speculations as to what would be the conditions under which beings like ourselves would exist if inhabiting the planets have often been brought forward, and Mr. Proctor has treated the matter in the same careful and exhaustive manner which characterised his admirable work "Saturn and its System." In the small space at our command we must be satisfied with a cursory glance at the contents of the work, to which we may recur at a future period. The author discusses the probable conditions under which life, such as we find on the earth, could exist on the other bodies composing the solar system; he assumes that the sun is not the abode of life, while Venus and Mars, the latter especially, may be inhabited by beings like ourselves. Mercury could only be peopled by the like under some special arrangements suitable to its condition of close proximity to the sun. Jupiter, Saturn, Uranus, and Neptune, Mr. Proctor does not consider habitable, but, on the contrary, arrives at the conclusion that it is more likely that their satellites are the abode of life, the primary planet in each case acting as a sun, and to some degree supplying both light and heat to the satellites. Although the author's views will be of great service in directing attention to these subjects, it cannot be denied that some of them will not be received without hesitation. Mr. Proctor is undoubtedly a theorist to a great extent, and many practical astronomers would prefer to leave certain questionable phenomena unsettled than to accept the explanations given by our author. The theory that the sun is uninhabitable may be questioned; we are scarcely yet sufficiently acquainted with the nature of the solar atmosphere, or its distance from the true surface of the sun, to give a decisive opinion on the subject. That the sun also is a variable star of about 11 years period, as seen from other systems, though a theory often brought forward, is, we scarcely think, well established. It is only occasionally that we can see a solar spot on the disc of the sun with the naked eye, while that disc subtends half a degree. Of what portion of light would any spots that we are acquainted with deprive an infinite bright point, such as the sun would appear at the distance of a fixed star? supposing that the sun appeared as a star of the sixth or seventh magnitude, to reduce it to the seventh or eighth, would not an eighth part of its surface have to be obscured? Mr. Proctor gives credit to the square-shouldered appearance of the planet Saturn, as noticed by Sir W. Herschel, and considers that a real alteration in the shape of the planet is admissible; concluding also that it may be owing to a similar change in the shape of Jupiter that one of the satellites, as recorded by Smyth, reappeared a considerable time after having entered on the planet's disc. We can only say that any explanation making Jupiter assume the attributes of a collapsing and expanding body is, in Mr. Proctor's own words, surprising. Surely, the micrometrical measurements of the planet are sufficiently numerous and trustworthy to prevent the suspicion of such a peculiar condition of circumstances. Is it not the case that the squareness of Saturn, the satellite of Venus, and the supposed planet Vulcan, are treated as astronomical myths, and not accepted

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by practical observers of the present day, with the powerful means both as to light, and more particularly as to definition, which now exist? These objections, however, will only show that Mr. Proctor's work is one demanding attention; and our space forbidding us to say more, we heartily recommend its perusal to every lover of the science. Unlike many scientific works, a tone of reverence towards the Creator of all things runs through the book, which is greatly to be commended.

SALES OF ASTRONOMICAL INSTRUMENTS.

A correspondent has asked us to communicate to our readers information beforehand of sales of astronomical instruments. He states that at the recent sale of the Hartwell instruments, many friends would have willingly come up to London, and have given more for certain of the instruments than the absurdly low prices which they fetched. We should be glad to give this information; but the fact is, the auctioneers do not seem to think it worth their while to inform us when they are about to sell; and if we obtain any knowledge previously, it is by a chance sight of the notice in the newspaper advertisements. We were not aware of the day upon which the Hartwell instruments were to be sold, and of the following sale we knew the particulars too late for insertion in the last *Register*. Our readers may be interested in seeing what the instruments fetched, and we therefore append the prices of the principal lots.

SALE AT STEVENS'S SALE ROOMS, COVENT GARDEN, MAY 20.

	£	s.	d.
Two large sextants (each)	7	7	0
Thirteen theodolites, each, from £3 12*s.* 6*d.* to	6	6	0
9-inch theodolite	9	10	0
Chronometer, by *Pennington*	17	17	0
22 lots, consisting of 32 chronometers (The highest price £9 10*s.*, the lowest £3 5*s.*)	190	0	0
A gold pocket chronometer, by *Barraud*	10	15	0
A ditto ditto	13	10	0
A metal ditto ditto	4	10	0
A gyroscope, by *Cooke & Sons*	5	10	0
Sextant and stand, by *Troughton*	5	0	0
Equatorial telescope, by *Cooke & Sons* (the same which was exhibited in the Great Exhibition, 1862), 4½-in. aperture, 6 ft. focus, with clockwork, 7 eye-pieces, diagonal, position micrometer, with 5 eye-pieces, &c., very complete and in perfect order; cost upwards of £300	100	0	0
Transit instrument, by *Troughton & Simms*, 2¼-in. aperture, 2 ft. 6 in. focus, on cast-iron stand, with 3 eye-pieces, and reflecting eye-piece	15	0	0
Collimator, mounted on stone	2	2	0
Eight-day sidereal clock, by *Charles Frodsham*	46	0	0
The observatory (with anemometer, by *Casella*); the building by *Cubitt*; dome 7½ ft. diameter, with transit room attached, about 6 ft. square (cost about £150)	21	0	0
Small equatorial, on Dr. Dick's plan, in mahogany case	12	0	0
Transit instrument, by *Jones* (about 18-in. focus)	7	0	0
7-in. object glass, in brass cell	4	4	0
5-in. ditto ditto	2	12	6
Astronomical telescope, unmounted, by *Wray*, 5-in. aperture, 6 ft. 6 in. focus, with 4 eye-pieces	16	10	0

The Astronomical Register is intended to appear at the commencement of each month; the Subscription (including Postage) is fixed at **Three Shillings** per Quarter, *payable in advance*, by postage stamps or otherwise.

The pages of the *Astronomical Register* are open to all suitable communications. Letters, Articles for insertion, &c., must be sent to the Editor, Mr. S. GORTON, *Parnham House, Pembury Road, Clapton, N.E.*, **not later than the 15th of the month.**

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The Astronomical Register.

No. 91. JULY. 1870.

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ROYAL ASTRONOMICAL SOCIETY.

Session 1869–70.

Eighth Meeting, June 10, 1870.

W. Lassell, Esq., F.R.S., *President*, in the chair.

Secretaries—Dr. Huggins, F.R.S., and Professor Pritchard, F.R.S. (*pro tem.*)

Professor Pritchard explained, that he occupied the position of Secretary in consequence of the resignation of Mr. Stone, who had been appointed Astronomer-Royal at the Cape of Good Hope, in the place of Sir Thomas Maclear.

The Minutes of the last meeting were read and confirmed.

Forty-seven presents were announced, including the observations made at Mr. Barclay's private observatory, between 1865 and 1869, and Mr. Proctor's New Star Atlas. The thanks of the Society were voted to the respective donors.

Captain D. Smith and J. Dickinson, Esq.,

were balloted for and duly elected Fellows of the Society.

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The following communications were announced, and partly read:—

Extract of a Letter to Mr. Hind, announcing a New Comet: by Dr. Winnecke.

The comet was discovered at Carlsruhe on the night of May 29–30, in the constellation Pisces. Its place, as ascertained by comparison with known stars, was, R.A. 0h. 50m. 9s., N.D. 28° 52′ 18″. The weather had been unfavourable for observations since, but it appeared as a round, pretty bright nebula, about 2½ minutes of arc in diameter.

Observations of the same Comet at Stonyhurst: by Mr. Perry.

The comet was seen on June 6, with the 12-foot equatorial. Its brilliancy was greater than that of the comet discovered last year by Dr. Winnecke, as it was readily picked up, notwithstanding the light of both sun and moon. The corrected place, at 17h. 48m. 38s., G.M.T., was, R.A. 0h. 57m. 3·6s., N.P.D. 62° 49′ 31″; clouds on the 7th and 8th prevented further observations. Mr. Perry had swept in vain for D'Arrest's comet.

Mr. Chambers had made a careful search with a 4-inch telescope for Winnecke's comet, but failed to find it.

Mr. Carrington saw it last Sunday evening.

On the alteration in Colour of the Belts of Jupiter: by Mr. Browning.

In the report of the Astronomer-Royal to the Board of Visitors there is the following remark:—"There has been little opportunity of employing the instrument on other objects, except in a drawing of Jupiter by Mr. Carpenter. The comparison of this with drawings made eight or nine years ago appears to negative the idea of any change in the colour of Jupiter's Belts." With all possible deference to the Astronomer-Royal and to Mr. Carpenter, the author points out that a comparison of drawings made either this year or last year, with others made eight or nine years ago, might not throw any light on this question. There is some reason to believe that the change in colour in the equatorial belt of Jupiter is periodical. This belt of the planet at the time mentioned may have been of the same colour that it has been during the last presentation; that it was not the same colour during the last presentation that it was on the previous presentation is a fact attested by some six or seven at least well-known and skilful observers. It is true that, in nearly every case, these observers were using *reflectors*, of apertures varying between 6 and 12 inches; but other observers, who have used achromatics, varying between 4 and 8 inches, have informed Mr. Browning that they have distinctly remarked the change in colour, although they do not seem to have seen it so plainly as

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those who have used reflectors. Unfortunately none of these observers have published the results of their observations. The change has been one that might have been easily observed, even by those who have not a quick eye for colour, by reason of the fact that the equatorial belt, which is ordinarily the brightest portion of the disc of the planet, and is so represented in every drawing Mr. Browning has ever seen of it, was, during the last presentation, much darker in colour than the bright belts of the north and south. There is a singular agreement between observers who have described this phenomenon. The colour has been described as yellow, ochreish-brown, and tawny. All agree in ascribing this colour to the equatorial belt; a portion of the planet ordinarily seen of a pure, or, at most, a pearly white.

On a Spectroscope in which the minimum angle of Deviation and the Prisms are automatically adjusted for the particular ray of the Spectrum under examination: by Mr. Browning.

The spectroscope, as usually constructed, is liable to two sources of error. One is, that only the particular ray for which it is adjusted passes parallel to the base of the prisms; and secondly, that as the face of the last prism is fixed while the telescope receiving the light from it moves, it is only when viewing the middle of the spectrum that the field is full of light, and that at the extreme ends, where most light is wanted, only a part of that passing enters the telescope. In the instrument exhibited to the meeting the prisms are hinged on the base plate, so that they can be moved on their centres, and each has a slotted bar, moving on a centre common to all the prisms. The last prism is connected by a lever to the telescope which, in moving itself, carries the prisms through an angle double that of its own motion. Thus, while the prisms are kept in the same relative positions to one another, their angle is changed with regard to the telescope, and the ray of light which is being observed always passes parallel to the base of the prism. Mr. Browning illustrated by a diagram that the result was, that instead of a lens-shaped appearance of the extreme red and violet, the field was full of light. The telescope is connected with a micrometer screw, and when this is clamped the telescope can only be moved by the screw, and carries with it the prisms, keeping them exactly in the required positions. About three years ago Mr. Browning had been urged to contrive such an arrangement for Mr. Gassiott's great spectroscope, but he did not then see his way to the result, and as the Sun was not then being mapped at Kew he postponed the matter; but having had the desirability of such an arrangement again impressed upon him by Mr. Lockyer, he had constructed this instrument, and, from its reception by the most eminent scientific men, hoped it would greatly assist in physical researches.

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The President, in the name of the Society, thanked Mr. Browning warmly for this most important addition to the spectroscope.

Dr. Huggins said, that one great advantage of the instrument was, that it gave additional light where it was most wanted. In the usual forms much of the light passing from the collimator was lost, being cut off at both ends, but here the whole pencil of rays became effective.

Mr. De la Rue: There is another obvious advantage in being able to pass from one end of the spectrum to the other without any adjustment. In other instruments the telescope had to be moved first and then the prisms. The difficulty had been attempted to be remedied by the use of an elastic spring, but he must compliment Mr. Browning on his very superior arrangement of the apparatus.

Professor Pritchard said, that he had had the opportunity of studying the instrument for some hours with great pleasure, and had thought much about it, but was not quite certain it was mathematically perfect. One thing he was sure of—that all the prisms did not act in a circle. We must go gradually to work. First get hold of the light, then make it travel parallel to the base of each prism while passing through it. He could not feel sure that this was done until he saw it mathematically proved, although he had no doubt the approximation was exceedingly close. Two things were wanted; first the light, and then to get the incident and emergent rays at the same angle with the sides, or, in other words, that the ray should pass parallel to the base. This would be perfection, but with anything less the true image would not be as aplanatic as it might be, and the measures not absolutely perfect. He should like to know whether Mr. Browning considered this was completely done?

Mr. De la Rue: Each ray, as it is examined, is parallel to the base of the prisms.

Professor Pritchard: That is what I doubt. That is the condition of the problem. If satisfied, the instrument is perfect; but, whether or no, its ingenuity is great.

Mr. De la Rue: Can this condition be secured by any particular turning of the prisms?

Professor Pritchard: Yes. What I mean is, that supposing the ray E to pass through the prism parallel to the base, I doubt whether, when the telescope is shifted to G, C, B, &c., these rays also are passing parallel. If so, the spectroscope is perfect.

Mr. De la Rue was much indebted to Professor Pritchard for his explanations, and felt certain, as a mechanist, that, the conditions being understood, the required motions could be given.

Mr. Browning also felt much indebted to Professor Pritchard for

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the attention he had given to the subject. He (Mr. Browning) certainly did not claim that the instrument was mathematically perfect, but, knowing the gross imperfections of ordinary spectroscopes, he considered this one practically perfect by comparison. The field being full of light at the ends of the spectrum showed that the rays were parallel to the base of the prism. Such an instrument was, perhaps, not suited for absolute determinations, being too complicated; but for other purposes he believed it was fully competent. Mr. Gassiott's great spectroscope had occupied 18 months in making and cost 350*l.*, and only showed 5 lines in the D group, but several persons had seen 13 lines with this spectroscope, proving its definition perfect. In fact, it saved the enormous waste of time caused by adjusting each prism to the minimum deviation for each ray, as Kirchhoff and Bunsen took the trouble to do between each observation.

Dr. Huggins: The instrument does all that can be required, and would not be improved if mathematically perfect. Such a spectroscope as this must alter from day to day, and could not be used for the absolute determination of wave lengths. Its proper use is, as an instrument of comparison.

Professor Pritchard: It appears to me to be an immense advance on the usual construction, and is exceedingly ingenious.

Dr. Huggins: Certainly it is a great advance on all where the prisms do not move. I have not seen Elliott's instrument with a spring, but think this must be better.

The President: I suppose it is very costly. What would a dozen come to?

Mr. Browning: I should be very sorry to take an order for a dozen.

Lieut. Brown enquired whether the prisms were all of the same glass?

Mr. Browning: Yes. They are Chance's dense glass, but not his double dense. The latter glass has so much lead in it that it becomes discoloured from the sulphur always about, such as the neighbourhood of india-rubber bands, &c.

Note on Father Secchi's Letter to the Academy of Sciences, April 25, 1870: by Mr. Seabrooke.

The author having been allowed the use of Mr. Lockyer's telescope and spectroscope for some time past, thinks it right to add his testimony to Mr. Lockyer's as to the correctness of the latter in the matter discussed in Father Secchi's communication. He (P. S.) therein states that the velocity of rotation at the Sun's equator, being equal to 2 kilomètres per second, is sufficient to account for the change of wave length in the lines referred to. In a former paper he had stated this velocity at 429 kilomètres, but Mr. Seabrooke considers he is mistaken altogether, and that

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neither rate will account for the changes seen. Other arguments are adduced, to show that the Sun's rotation has nothing to do with the changes seen in the wave lengths and solar prominences in a few seconds.

Mr. Stone: If I understand the matter at all, Father Secchi has compared the bright lines with the absorption ones, and thought the bright lines only are altered by the Sun's rotation; but I do not see how any result is to be got out of such a proceeding, as both media must equally partake of the Sun's rotation.

Mr. Lockyer: The feeble dispersive power used by Secchi, combined with the light round the Sun of our own luminous atmosphere, produces an effect, which it is the object of the new method used by me to get rid of. When the slit of the spectroscope is tangential, he has half of it full of the Sun's light and half of our atmosphere, so that, where there is no prominence, he will see the bright lines of the chromosphere and the dark ones of the atmosphere above. The bright lines are solar, and the dark ones coincident with them belong to our atmospheric glare. I can do the same thing by taking off some of my prisms, but the observations are not, in such a case, the best that can be made. In fact, with such atmospheric glare I should leave off observing. Father Secchi persistently ignores all that is done in solar physics, and declares that there is nothing in the alterations of wave lengths and other things which have been discovered here. He stated, that having calculated with considerable accuracy the motion of a particle at the Sun's equator, he found it to be 429 kilomètres a second, and having ascertained, from Kirchhoff's and Angstrom's maps, the alteration in wave length due to that displacement, he observed the Sun, and said he got such an alteration, one way on one side and the other way on the other side; but Volpicelli and Fizeau soon pointed out that the velocity is only 2 kilomètres a second, and Secchi now thinks that enough for his theory. Altogether, it looks as if he had made a great mistake, and Mr. Seabrooke's paper points out that we need not go to opposite sides of the Sun at all, but can get, in any prominence, in 20 minutes, such an alteration in the wave length of the hydrogen line.

On the determination whether the Corona is a Terrestrial or a Solar Phenomenon: by Mr. Seabrooke.

Mr. De la Rue gave some account of this paper, which was presented at the last meeting, and drew a diagram in illustration. The object is to show that Mr. Lockyer's theory of a terrestrial origin for the corona is possible, without stating that other views are wrong. It discusses what has been seen in eclipses before, and what ought to be seen, according to the theory. At the Indian eclipse Major Tennant saw a faint continuous spectrum. In America, Professor Pickering, with an ordinary chemical spectroscope, saw

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a continuous spectrum with bright lines. The author's theory of what we ought to see during an eclipse is, that the bright lines erase the absorption lines where they belong to the same substances, but in some cases they do not coincide, so that certain bright lines are left.

Mr. De la Rue said that some confusion seemed to exist as to what was to be implied by Major Tennant's mention of a continuous spectrum. He did not think Major Tennant meant that he saw such a spectrum as would be produced by an incandescent solid, but merely that he did not find a bright line spectrum, which he might rather have expected. The American observations were difficult to account for, but he certainly thought the instrumental means were insufficient. There was one palpable objection to the view advocated in the paper—that it was evident, if the corona were produced by some portion of the photosphere illuminating our atmosphere, the most distant part would naturally be the brightest; but this was not the case, as the part nearest the Moon's edge was intensely bright. He would not say that the theory might not account for some part of the corona, but he was convinced the brightest part was solar in nature and not terrestrial. It was probable that some portion of the corona was due to our atmosphere, and it was right to discuss all points, and get every possible information before the next eclipse.

Dr. Gould, the eminent American astronomer, having been introduced to the meeting, and requested to give his opinion on the nature of the corona, said: Having only arrived in London at 4 o'clock this afternoon, from a rather tempestuous passage of 13 days, I feel somewhat unable to address a meeting of this kind in a satisfactory manner, on a subject requiring careful consideration. I have had the good fortune to witness an eclipse at a point where photographs and other observations of the best kind were made by a large party furnished with every needful appliance. They were divided into three groups, at about 30 miles apart. I was stationed at Burlington, in Iowa, where the photographs obtained show a great degree of perfection. I was only a few feet from the photographic telescope and devoted myself to the visual observation of the corona. My telescope was of large aperture, 5 inches, and very low power, 5 diameters only, so that the whole of the corona was visible in the field, and was very brilliant. It was so bright before and after the totality, that I only knew when this began and ended by the noise of the crowd. As the record of my observations, I am prepared to state that the corona varied very essentially during the totality. I made three sketches during the 3 minutes of the eclipse, and two friends verified them at the moment, using opera-glasses and the naked eye. These drawings ought to have been printed and published long ago, and will represent what appeared to

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be the case to me, and corroborated by others. I hope they will ... that it is so out in less than a month now. These outlines of the corona ... is seen in our show well-marked rays, not coinciding with the points of the c... it hardly neces pass, with the Sun's equator, or with the prominences. Secon... Dr. Gould sett we have the photographs. Professor Meyer's were made at ... Still it might lington with a 9-inch aperture. Another set were taki... light in the ne Ottumwa, 35 miles off. Both of these sets had the focal ... He had calculated th enlarged to about 2 inches. Two other series of pictures ... numbers equal to our taken by officers of the United States Coast Survey ... totality would be enlargement and with long exposures; that is to say, the ex... believe that the corc pictures were exposed from 5 to 15 seconds, and the others ... to 70 seconds. Another set of pictures was also taken b... to lay great strea Curtis, from the Washington Observatory, at Des Moin... form of outline and si 500 miles to the west of Burlington. They were very ... eclipse was 3m. 25s. enlarged, and have been copied on a larger scale. We hav... minute. These show fore, two sets taken in the primary focus, two sets in a ... superposed had no ... focus, and one other set. Now the point is, that in all t... eclipse would confirm th tographs, without exception, there is a minimum diame... moment, as the Sun dc corona at the solar axis, and I think a maximum at ... at did. equator. This being certain beyond all reach of ca... The zodiacal light var follows that if the position of the axis is clearly mark... are sh corona must belong to the Sun. Leaving the photo... believes graphs going to the eye-views and drawings, there is no t... said, the ph outline of the visible corona of connection or rela... corona wa axis, equator, or prominences of the Sun. These are ... The same ... promin inference is, that what we *saw* is one thing, what ... number of ... r, by Re *graphs record* is another. There is no escape from ... the equat structure out discrediting my own observations, on which I am ... simple in they are rely. ... equator

Mr. De la Rue said he hoped Dr. Gould woul... wonderful spiral fo pointed question; but he should like to ask wheth... the poles they are did not think some of the corona distinctly belonge... but at the eq nator in and might be distinguished from any atmospherical ... m, and the line G in Whether, in fact, these were not two separate thing... ies see usually confounded together? ... The peculiari ption c ... the greater er other.

Dr. Gould: I confined myself to facts; but have... more than an phot in stating my personal conviction as to the visible ... In 1860 the the eye and the telescope we get a phenomenon wh... which were not seen b I am not able to assert it is terrestrial, I cannot se... doubtless, posse is. The visible corona overlaps and screens ... power. In which clearly is connected with the Sun, and ... the Sr believe it is the chromosphere; but this ide... m met by laughter; and I was asked how a ... measure 14′ in the photographs? I only ... what it is called, but there ... Eve diminution of this light in ... th

escape from the inference that it is something belonging to the Sun, and nothing like it is seen in our eye-views.

Mr. Proctor thought it hardly necessary to continue the discussion, as he assumed Dr. Gould settled the point in favour of the corona being solar. Still it might be interesting to notice the question—what the light in the neighbourhood of the Sun really might be. He had calculated that, supposing a mass of meteors there in numbers equal to our November meteors, the light produced during totality would be equal to that of the full Moon. He did not believe that the corona was in any part terrestrial.

Dr. Gould desired to lay great stress on one point—that the corona varied its form of outline and streamers from moment to moment. The eclipse was 3m. 25s. long, and pictures were taken about each minute. These showed only a family resemblance, and when superposed had no agreement. He believed the December eclipse would confirm this. If the corona varied from moment to moment, as the Sun does not do this, it must be something else that did.

Mr. Proctor: The zodiacal light varies, and so do the tails of comets, but no one believes they are atmospheric.

Mr. Lockyer said, the photographs referred to by Dr. Gould showed that the corona was more extensive elsewhere than at the Sun's poles. The same thing had been noticed with regard to the height and number of the prominences, which are found to be greatest round the equator, by Respighi. The prominences near the poles are simple in structure and not very high; but in the region of the equator they are not flat-topped like distant hills, but display wonderful spiral forms, and have a complex constitution. At the poles they are rarely injected with sodium and magnesium, but at the equator injections of these metals and iron are common, and the line G in the extreme violet is often very brilliant. The peculiarities seen in the photographs, therefore, arise from the greater eruption of materials rich in actinic rays at one part more than another.

Mr. De la Rue: In 1860 the photographs exhibited pictures of prominences which were not seen by any of the eye-observers; and therefore, doubtless, possessed only faint colour but great photographic power. In all the American photographs I see configurations next the Sun's edge alike in all, though taken 30 miles apart, and the more distant sets corroborate this. Such entities must belong to the Sun.

Mr. Carrington: How do you determine the axis of the Sun?

Mr. Lockyer: By the direction of motion across the slit of the spectroscope.

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The Rev. Mr. Howlett pointed out that the motion of the spots also gave the position of the axis.

Capt. Noble said that, as the Sun was under discussion, he should like to ask whether anyone had noticed how the faculæ had lately been seen much farther on the Sun's disc than usual; in fact, considerably towards the centre?

Mr. Carrington had observed this likewise.

On the Orbit of α Centauri, by Mr. Powell.

Note respecting Solar Spots visible to the naked Eye, by Mr. Hill.

It was moved by the Rev. J. V. Mummery, seconded by Mr. Birt, and resolved: That this meeting has heard, with extreme regret, that E. J. Stone, Esq., F.R.S., has resigned his appointment as one of the Secretaries of this Society, in consequence of his appointment to the directorship of the Observatory of the Cape of Good Hope. That this meeting offers to Mr. Stone its sincere congratulations on his having been called to occupy that important position, for which he is so eminently qualified, and sincerely wishes him long life and all needful health and strength for the honourable and satisfactory discharge of his new duties. That this meeting begs to express its deep sense of obligation to Mr. Stone for the valuable services rendered to this Society, in various ways, for many years, and its high appreciation of the intelligence, attainments, and gentlemanly bearing by which he has ever been distinguished.

The motion was carried by acclamation, and a copy of the resolution ordered to be forwarded to Mr. Stone.

Mr. Chambers having made an enquiry as to the progress of the arrangements for the Eclipse expedition, was informed that the matter was now placed in charge of an amalgamated Committee of the Royal Society and the Astronomical Society, and that a meeting would be held next Thursday at Burlington House.

A motion was likewise proposed and carried: That Mr. Cayley be requested to get out the Monthly Notice, reporting the present meeting, within a fortnight if possible.

The Society then adjourned till November.

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CORRESPONDENCE.

N.B.—We do not hold ourselves answerable for any opinions expressed by our correspondents.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

THEORY IN ASTRONOMY.

Sir,—Many thanks for your kind review of my *Other Worlds*. But may I ask, in what sense am I a *theorist*? If practical astronomy means making observations and there leaving them, I hope I am not a practical astronomer. If practical astronomy means making observations without enquiring whether they can by any possibility advance the cause of astronomy, I hope I am not a practical astronomer. But if practical astronomy means working with sole reference to what is useful and to what one can do best, I not only hope I am, but claim to be (to the best of my ability) a practical astronomer.

But what *is* practical astronomy? To take our greatest names,—shall we say Newton was not a practical astronomer because he never made himself half-blind by trying to divide difficult doubles with inadequate "power"? Is Adams a theorist, because he has not drawn up lists of occultations observed without any possibility that astronomy could be advanced thereby?

The fact is, your theorist is your only practical astronomer, just as the manufacturer is more practical than the man who should say, "Dig stores of metal, and let them lie by the mine's mouth; let flax and cotton grow, but never work them into fabrics; sow but never reap, or reap and let the wheat rot in your garners."

No, Sir; the Herschels have advanced astronomy more by theorising than even by their wonderful observing powers. Kepler, the theorist, did better work than Tycho the practical (for others could have matched what Tycho did, but there was but one Kepler), and astronomy will never be in so bad a case as when her cry is, "Observe, observe, observe; never mind *thinking*, whether *what* to observe, or about what you *have* observed, but always *keep on observing*."

Yours faithfully,

London: June 2, 1870. RICHn. A. PROCTOR.

OCCULTATION OF O^2 LIBRÆ.

Sir,—I know not how Mr. Gould missed the occultation of this star on May 14. Perhaps it was owing to the glare of the moon, which sometimes prevents a small star being noticed, unless looked for in its precise place. Mr. G., however, overlooks the large effect of parallax. The moon being comparatively very near the earth at the time, and also not far from the meridian, that effect, especially on the *declination*, was very considerable. Roughly computed, it must have been more than 55′. In looking at the column of "Elements of Occultations," in the *Nautical Almanack*, where the difference of apparent declinations of moon and stars is given, it will be observed that even larger differences than on this occasion do not prevent an occultation taking place. If we add together the moon's semi-diameter, and horizontal parallax for midnight on May 14, we find it 77′ 49″, and the difference of declinations of moon and star at the same time was only 68′ 13″; so that the difference, 9½′, leaves plenty of room for an occultation. What is necessary for any star, that can ever lie in the moon's

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path, to be occulted is, that at the time of the junction of moon and star, the difference of latitude of the two should not exceed the sum of the moon's apparent semi-diameter and her parallax. Applying this rule, and taking the latitude of O^2 Libræ from a globe, as $3\frac{1}{4}°$ N., or, for greater accuracy, by computation, as 3° 20′, and subtracting it from 4° 25′, the moon's latitude, we have 65′, which is less than the above sum by more than 12′.

By means of a merely rough calculation and diagram, I find the immersion of O^2 Libræ was at about 11 h. $24\frac{3}{4}$ m. mean local time at Reading; and that the star must have been above 40 m. occulted.

It may not be superfluous to remind some who use the excellent star maps of the S.D.U.K., that the equinox on them is now wrongly placed by about 25′, and that the R.A. and declination of the stars have been more or less affected by the same cause (precession). But, for general purposes, this is of little consequence.

It may be that, occasionally, "bonus dormitat Homerus"; but it is a rare thing to catch the computers of the *Nautical Almanack*, with such a superintendent as J. R. Hind, napping.

Yours faithfully,

June 7. GEORGE J. WALKER.

D'ARREST'S COMET.

EPHEMERIS FOR JULY:—

Berlin Mean Moon.

1870.		R.A. h.	m.	s.		N.P.D. °	′
July 1	...	15	27	14	...	78	20
3	...	15	26	46	...	78	44
5	...	15	26	28	...	79	10
7	...	15	26	20	...	79	37
9	...	15	26	24	...	80	6
11	...	15	26	38	...	80	37
13	...	15	27	3	...	81	10
15	...	15	27	39	...	81	44
17	...	15	28	27	...	82	20
19	...	15	29	26	...	82	57
21	...	15	30	36	...	83	36
23	...	15	31	57	...	84	16
25	...	15	33	31	...	84	57
27	...	15	35	15	...	85	40
29	...	15	37	12	...	86	24
31	...	15	39	40	...	87	9

From Mr. G. F. CHAMBERS, Bickley.

GRUITHUISEN'S CITY IN THE MOON.

Sir,—I have lately had a most excellent view of this curious object, which Gruithuisen discovered in 1822, and which he considered to be an artificial collection of gigantic walls.

He describes it as consisting of a central ridge running north and south, with a number of parallel walls branching off at an angle of 45° from it, like the ribs of an alder leaf. The ridges east of the central stalk flattened gradually down, whilst on the west they formed, with a cross ridge lying north-west, enclosed spaces; he also stated that it was very dark, was situated in one of the darkest regions of the moon, and was only to be seen on the terminator.

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I made out the details described by Gruithuisen very well on June 7, but it was not until the 8th that I examined the region carefully; on this evening, from 9h. to 10h. definition was very good, and using a beautifully defining achromatic eye-piece, giving a power of 250 on my 6½ silvered-glass reflector, I found the "city," although so far from the terminator, which passed through the centre of the Sinus Iridum and bisected Euclides, an easy object, and I could identify very well the details recorded by Gruithuisen. The central ridge commenced at the north at a hill, Γ, of Beer and Mädler, which had a small craterlet lying just north of it, and ran south nearly up to the ring of a craterlet "a," with a central hill, when it branched out south-west and south-east.

On the west I counted five ridges running off in a south-west direction, the first of which from the north was the most conspicuous, and cast a slight shadow; Gruithuisen's cross ridge, running in a north-west direction from the craterlet "a," and enclosing the transverse valleys, was very plain, and I could trace a prolongation of the second ridge from Γ beyond it to another range of hills.

East of the central mound I counted four ridges, running off from it in a south-east direction, which, however, were not so distinct as those on the west, and gradually died away into the surrounding plain.

The ridges being white, on a dark grey background, gave a very regular appearance, and closely resembled the ribs of an alder leaf, as Gruithuisen described it; but though curious, the whole object looked undoubtedly natural.

Those who have not seen this extraordinary formation will find it well worth the search, and it can be made out much further from the terminator than Gruithuisen states; indeed, I faintly traced it when the terminator had passed it nearly 30°; but with a small instrument, no doubt it should be looked for just after sunrise or before sunset.

Penarth, Truro: June 11, 1870. H. MICHELL WHITLEY.

SUSPECTED CHANGES ON THE MOON'S SURFACE.

Sir,—May I solicit the attention of lunar observers to the present appearance of a rather conspicuous crater, Theophilus A of Beer and Mädler? It is marked G in section 11 by Lohrmann, whose delineation of it is the earliest that I am acquainted with. It is without a central mountain, and a ridge on its north runs towards it and adjoins its N.E. border. Beer and Mädler at a later epoch give a ridge *terminating* at the north border of the crater and an interior mountain eccentrically situated towards the south border. In Rutherford's photogram, 1865, March 6, a ridge is seen *within* the crater continued from the exterior ridge, as given by Beer and Mädler; the termination of this ridge appears to be concealed by the bright illumination of the interior of the south border. On the evening of May 6, 1870, 8 to 8.20 G.M.T., I made the following record:—"IV B γ 8 west of Theophilus is a remarkable crater; a ridge in continuation of a "crater row" N.E. of Isidorus has penetrated into its interior nearly to its S.E. border. This ridge appears to have been produced subsequently to the formation of the crater, having pushed up its north border. When I recorded the above I had not consulted the before-mentioned authorities.

I am, Sir, your obedient servant,

Cynthia Villa Observatory, W. R. BIRT.
Walthamstow:
May 7, 1870.

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THE MOON'S MOTION.

Sir,—As a rejoinder to one of the sophisms of "A. Elvins," on page 261 of the *Register* for 1869, I beg to submit the following:—

When Mr. Elvins next stands on the edge of a turn-table let him place a mariner's box-compass on his head. As the table turns round Mr. Elvins will face every point of the compass, but the compass card will always remain fixed in its directions.

Now either Mr. Elvins or the compass card must have turned round itself during the time of one complete revolution of the turn-table.

Mr. Elvins, page 261, positively asserts that he does not turn, and about 100 per cent. of mariners, together with 99 per cent. of astronomers and other scientific men, will just as positively assert that the compass card does not turn, but that the box is turned round under it. Query, which is true? Is it not just possible for Mr. Elvins to be turned round, like the box on his head, and not know it? SATELLITE.

OBSERVATIONAL NOTES, 1870.

By C. Grover, Assistant to John Browning, Esq., F.R.A.S.

The return of Summer with its long and brilliant days and correspondingly brief nights (or rather the absence of anything like real dark sky altogether) has seriously curtailed our opportunities of observation. This enforced period of relaxation is not, however, to be deeply regretted, since, apart from the pleasure we desire from the contemplation of the beautifully varied aspects of the natural world at this season of the year, we find leisure to ponder over and properly estimate the value of our previous studies, and when with the change of seasons our opportunities for observations again recur, we recommence with increasing interest our studies of the celestial wonders.

It must be owned that the making of observations, or rather the mere gazing at various planetary or sidereal objects, is a much more agreeable task than the arrangement and classification of really useful and instructive results for the perusal of others. Yet we know that observations only acquire value in proportion as they are communicated to observers, either as a means of comparison or as a guide to objects of special interest. Considerations of this nature have led me to communicate occasionally to the *Register* various papers on what might otherwise have been deemed unimportant subjects, but which I have reason to know have not been altogether useless; and as a continuation of such notes and gleanings I am induced to commence a record of my experience in the use of a 12¼-inch silvered-glass reflector.

Almost the first thing to attract my attention in working with this instrument, which is equatorially mounted, was the great advantage of having a clock motion, at once simple, efficient, and easy of control. The importance of such an addition to any tele-

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scope is forcibly shown by the remarks of the late Admiral Smyth, at page 341 of the first volume of his *Cycle of Celestial Objects*, in the course of which he states, "This permits such steady gazing that one of its effects is equivalent to an increase of optical power." This refers to the benefits derived from its application to his $5\frac{9}{10}$ achromatic, with which I had the pleasure of observing in 1865, at the Hartwell Observatory of the late Dr. Lee. As this was one of the first instruments so provided, it is only necessary to state, as the reader may well imagine, that in the long interval since elapsed, many great alterations and improvements have been introduced; and in the present day, several large and very massive instruments are driven by ingeniously-contrived mechanism with an ease and precision truly surprising. It is not only a great luxury to have both hands left free to make drawings or manipulate micrometrical measures, but the results of observations under such circumstances are all the more likely to prove accurate, or at least to approach very nearly to accuracy, from the fact that the mind, being freed from all care as to the direction of the instrument, instinctively concentrates its energies with increased force on the object under examination.

It is a well-known fact that the separating power of the telescope depends almost entirely on its aperture. This is most beautifully shown in the writings of the late Rev. W. R. Dawes, whose wonderfully perfect vision has probably never had its equal, certainly no superior. His skill in the use of the achromatic telescope justly entitled him to be called the prince of English observers. And it is a matter for deep regret that he was not permitted to carry out his intention of thoroughly investigating the capabilities of the silvered-glass reflector, since, although we know that, as regards the relation of aperture to dividing power, the effect is the same with either object-glass or speculum, yet it cannot be doubted that the experiments of this eminent observer would have possessed a very great degree of scientific interest.

It will be seen from my former communications to the *Register* that I had used mirrors of $4\frac{1}{2}$ and $6\frac{1}{2}$ inches diameter. Many of the objects thus observed have been re-examined with the $12\frac{1}{4}$-inch speculum, and the changes in appearance of celestial objects, caused by varying aperture, irrespective of magnifying power, are somewhat startling, even to a practised observer. A striking instance of this effect has been observed in the well-known trapezium in the great nebula of Orion. With the $4\frac{1}{2}$-inch mirror the four stars are, of course, readily seen. The $6\frac{1}{2}$-inch speculum increases their apparent distances, shows the 5th star steadily, and on very fine nights just glimpses the 6th. In the $12\frac{1}{4}$-inch telescope the apparent separation of the four principal stars is vastly

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increased, the 5th and 6th stars are readily visible as well as several other minute points only to be picked up by first-rate instruments. These observations being all made with the same eye-piece, and with mirrors of nearly equal focal length, it follows that the magnifying power must also have remained nearly the same; and, as this in no case exceeded 250, the result clearly proves that more is gained by increasing aperture than by the application of enormous magnification.

Amongst other objects which I have re-observed are—the close double following Procyon, and the neat pair a little south of the well-known Castor, both of which are, of course, far beyond either the $4\frac{1}{2}$ or $6\frac{1}{2}$-inch mirrors; they are, however, easily separated with the same eye-piece on the $12\frac{1}{4}$-inch speculum. Although these two pairs are both about the same distance apart, viz., half a second of arc, that near Castor is more difficult of separation than the other, simply from the fact that the components being three magnitudes brighter, the increasing brilliancy renders it somewhat difficult to free the little discs from a small quantity of loose light.

With regard to the double following Procyon, an astronomical friend has pointed out (and, as I think, with some reason) the liability of a mistake in the identification of this object, especially in the case of inexperienced observers, who may be led to mistake P. VII. 170 for the test object. A little care, however, will prevent this, by remembering that the brilliancy of the components of P. VII. 170 exceeds that of our object by two magnitudes,—that they are separated by nearly three times the interval,—that P. VII. 170 is about twice as far from Procyon, and a little south of our object, and is by far the brightest star in this direction.

In speaking of the apparently increased distances of the compound stars with enlarged apertures, I have incidentally referred to the increase of illuminating power. This effect is so well known as to require no comment, but that it has been brought most forcibly to my mind by the remarkable splendour of that brilliant ornament of the winter sky—Sirius. This star, though presenting a much smaller disc than with lesser apertures, shines with such an intense and overpowering blaze in the $12\frac{1}{4}$-inch speculum, that the observation speedily distresses the eye—so much so as entirely to prevent the examination of anything like minute stars for at least a quarter of an hour afterwards, or until the eye has had sufficient repose for the pupil to dilate, and thus recover its usual sensitiveness.

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A New Star Atlas.—By R. A. Proctor, B.A., F.R.A.S. London: Longmans.—The chief objection to the otherwise excellent star maps formerly published by Mr. Proctor (the stars in 12 maps), was that, owing to the scale on which they were drawn, the stars were necessarily so minute, and so close together, that they required a powerful glass with which to see them properly, and were therefore scarcely suitable for the observatory, or for use by night. In the present fine atlas this objection is entirely done away with; the scale is sufficiently large to give all the stars, with ample space between them, and the maps are well adapted for use; in fact, each map, if properly selected for the time of year, when hung on the wall would be a faithful and easily recognised representation of the state of the heavens. Mr. Proctor is really a prince of celestial map-makers; he has thoroughly studied the subject, and assisted as he has been by Mr. Brothers, armed with the happy resources of photography, he has produced a star atlas upon which he may well be congratulated. The introduction will repay perusal; it shows with what care and patience the work has been prepared; in it the true principles upon which a star atlas should be constructed are described, and the steps detailed by which the present work was produced. We note that Mr. Proctor has introduced a new nomenclature for some of the constellations; there is no doubt that, if generally adopted, it would be an advantage, but we are so used to our present titles that a little confusion may be apprehended, and we fear it will be some time before we recognise in the constellations here named *Catuli*, *Corolla*, *Camelus*, *Felis*, *Leæna*, and *Cervus*, our old acquaintances, Canes Venatici, Corona Australis, Cameleopardalis, Canis Minor, and Monoceros. We fear these new names will be rather puzzling to those who search on the maps for stars picked from the existing catalogues. But we must really waive all objections in deference to the usefulness of the work before us, and can only regret that, in the short space at our disposal, we are unable to do justice to it; it shows all the stars visible to the naked eye, giving nearly 1,500 objects, the constellations being, from the nature of the plan employed, as little distorted as possible; it includes Sir J. Herschel's and Messier's Nebulæ; all Binaries, and suspected Binaries; Admiral Smyth's cycle objects; the red stars, the variables, &c., &c., corrected for precession to the year 1880, so as to be useful both for the present, and for a very long time to come. We may conclude by stating our opinion, that the full merit of these maps cannot fail to be discovered by use, and that they will be found to be the most comprehensive and clear of the charts of the heavens yet given forth to the astronomical world.

Lectures on Light.—By John Tyndall, L.L.D., F.R.S. London: Longmans. This is a reprint, in a handy form, of the notes which Professor Tyndall prepared for his Lectures on Light, delivered at the Royal Institution last year. It is scarcely necessary for us to draw attention to the value of these Lectures, by one who not only possesses the art of rendering difficult subjects clear to all understandings, but is perhaps the greatest living authority on the subject of light; and as there are many points more particularly interesting to students of astronomy, we have little doubt that the present work will be found acceptable to many of our readers.

The Annual Visitation of Greenwich Observatory took place on the 4th of June. The visitors began to assemble at 3 o'clock; everything as usual was in the greatest order, and gratification was afforded both to the astronomers and their non-scientific friends by what they found to look at. One great attraction was the new water telescope, which the Astronomer Royal explained to several who were curious on the matter.

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Up to half-past 4 the weather was cloudy; then the sun broke out, and gave an opportunity for examination by the great Equatorial of a very fine spot on the disk. The usual dinner took place afterwards at the Ship at Greenwich, where about forty-five sat down. After the toasts of the "Queen" "the Prince of Wales and the Royal Family," and the "Army and Navy" were proposed and responded to, ADMIRAL BELCHER returned thanks for the Navy. Although trusting not, as formerly, to wooden walls, he had no doubt that the seamen of the present day would be as ready to protect us with the new Iron Clads, when the occasion arose, as before. Captain Brown returned thanks for the Army; and remarked that he could give his assurance, that the officers stationed at Gibraltar would afford every assistance in their power to astronomers who might go there to observe the eclipse of the sun in December next. The toast of the Astronomer Royal and the Greenwich Observatory was received with enthusiasm; and in returning thanks, Mr. Airy made a very excellent and telling speech. He pointed out that the success of the Observatory arose from the pursuance of a steady and consistent course, aimed at one object only, utility; obtained by the continuance of observations, chiefly meridional, the result of a traditional but safe policy, having for its object the furtherance of astronomy and navigation. While observations of a more pleasing character, such as those connected with the spectroscope, the sun, or photography, might be safely left in the hands of Mr. Huggins, Mr. Lockyer, or Mr. De la Rue, although not entirely neglected in the Greenwich Observatory, the chief purpose of that establishment was to continue the rigorous observations by which the position of the solar system, the places of the sun, earth, and planets, and especially of that difficult object the moon, were correctly ascertained. Mr. Airy concluded by giving, in answer to Mr. De la Rue, a description of the construction and use of the new water telescope.* The toast of the "Admiralty" was then proposed, and responded to by Captain Richards. Mr. Stone also replied, on his health being proposed by the Astronomer Royal on the occasion of his appointment to the post of Director of the Observatory of the Cape of Good Hope. With the toast of the President of the Astronomical Society, responded to by Mr. Lassell, the company dispersed, apparently well gratified with the afternoon's proceedings.

SUN SPOTS.—Referring to the remarks I made at the last meeting of the Royal Astronomical Society, which you have reported, as usual, most correctly, will you allow me to draw prominent attention to the fact that Mr. Lockyer considers there is good cause for believing that the depth of the cavities, in the case of sun spots, is much less at the maximum of their frequency which we have now entered on, than at the time of the minimum. Thus your readers will see that the accuracy of Mr. Howlett's and my own observations is upheld, and the probability of there being a periodicity in this connection thrown out. I may mention that I did not make my

* "I alluded in the last Report to a telescope whose tube should be filled with water, for examination of the co-efficient of sidereal aberration when the pencil of light passes through a considerable extent of refracting medium. I have decided to use it in the apparent zenith-distances of Gamma Draconis at the proper seasons of the year. It is to be mounted upon the stone pier in the occasional Observatory (formerly Struve's Observatory), now planted on the south ground. The instrument admits of instantaneous reversion, with its micrometer in N. and S. positions; it admits also of being fixed with its micrometer in E. and W. positions, for determination of its scale. The construction of the instrument requires several unusual arrangements; amongst others, the means of cleaning the lower plate-glass from mud, and of cleaning the internal surface of the object-glass from bubbles."—*Astronomer Royal's Report.*

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remark in the discussion with any view to call in question the accuracy of Mr. De la Rue's valuable and laborious researches on sun spots, but merely to point out that, at the present time, there seemed to be a deviation from the general law in this respect. Mr. Lockyer's hypothesis will probably afford an explanation.

I am, &c.

111 Minories: June 2, 1870. JOHN BROWNING.

THE PLANETS FOR JULY.

AT TRANSIT OVER THE MERIDIAN OF GREENWICH.

Planets	Date	Right Ascension	Declination	Diameter	Meridian Passage
		h m s	° ′		h m
Mercury	1st	5 12 50	+20 26	7″·4	22 31·8
	15th	6 50 6	23 18	5″·5	23 13·7
Venus	1st	3 59 19	+18 26	14″·2	21 18·5
	15th	5 7 28	21 18½	13″·4	21 31·4
Saturn	1st	17 31 42	−22 4½	16″·6	10 55·5
	15th	17 30 48	22 4	16″·6	9 56·6

Mercury may be observed in the mornings, at the beginning of the month, rising about an hour and a half before the sun. This interval decreases until the 26th, when the planet arrives at superior conjunction, and is then about 2 degrees from the sun.

Venus passes the meridian about a quarter past 9 in the morning at the beginning of the month, and about half an hour later at the end of July. The planet is in conjunction with Jupiter on the 13th, and with Mars on the 29th.

OCCULTATION OF SATURN.—This planet will be occulted by the moon at about a quarter past 1 in the morning of the 11th, the immersion commencing at 13h. 16m. (of the 10th) and terminating at 14h. 12m.

ECLIPSE OF THE MOON.—A Total Eclipse of the Moon, visible at Greenwich, will take place on the evening of the 12th of this month, the following being the times:—

Greenwich Mean Time.		h.	m.
First contact with the penumbra,	July 12	7	46·0
First contact with the shadow,	,,	8	44·6
Beginning of total phase,	,,	9	44·4
Middle of Eclipse,	,,	10	34·2
End of total phase,	,,	11	24·0
Last contact with shadow,	,,	12	23·8
Last contact with the penumbra,	,,	13	22·4

Magnitude of the eclipse (moon's diameter = 1) 1·675. The first contact with the shadow occurs at 81° from the north point of the moon towards the east, the last at 87° towards the west; for direct image.

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ASTRONOMICAL OCCURRENCES FOR JULY 1870.

DATE		Principal Occurrences		Jupiter's Satellites		Meridian Passage
		h. m.			h. m. s.	h. m. Moon
Fri	1		Sidereal Time at Mean Noon, 6 37 20·9			2 17·6
Sat	2					3 10·2
Sun	3					4 1·6
Mon	4	2 5	Conjunction of Mercury and ζ Tauri, 5m·8 E.			4 51·9
Tues	5	16 30	☽ Moon's First Quarter			5 41·6
Wed	6		Saturn's Ring: Major Axis = 41″·3 Minor Axis = 18″·6	3rd Oc. R.	14 38	6 31·7
Thur	7					7 23·1
Fri	8			1st Ec. D. 2nd Oc. R.	15 38 4 15 40	8 16·5
Sat	9	18 55 22 55	Conjunction of Mercury and η Geminorum, 6m·3 E. Conjunction of Mercury μ Geminorum, 13m·2 E.	1st Sh. E. „ Tr. E.	15 0 15 45	9 12·5
Sun	10	12 38 13 44 12 54 13 16 14 12 15 50	Occultation of B.A.C. 5954 (6) Reappearance of ditto Conjunction of Moon and Saturn, 1° 4′ S. Occultation of Saturn Reappearance of ditto Conjunction of Mercury and η Geminorum, 0° 11′ S.			10 10·7
Mon	11					11 10·1
Tues	12	10 35	○ Full Moon Eclipse of the Moon.			12 9·1
Wed	13	7 23	Conjunction of Jupiter and Venus, 1° 7′ S.	3rd Ec. D. „ Ec. R.	13 33 46 15 35 52	13 5·8
Thur	14	13 5	Conjunction of Uranus with the Sun			13 59·2
Fri	15		Illuminated portion of disk of Venus = 0·783 of Mars = 2·973	2nd Ec. D.	14 16 50	14 49·0

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DATE		Principal Occurrences		Jupiter's Satellites		Meridian Passage
		h. m.			h. m. s.	h. m. Saturn
Sat	16		Sidereal Time at Mean Noon, 7 36 29·2	1st Sh. I. „ Tr. I.	14 41 15 32	9 52·5
Sun	17	10 56 11 59 12 55 14 9	Occultation of 30 Piscium (5) Reappearance of ditto Occultation of 33 Piscium (5) Reappearance of ditto	2nd Tr. E. 1st Oc. R.	13 25 15 3	9 48·3
Mon	18	14 50	Near approach of Moon to 20 Ceti (5½)			9 44·1
Tues	19					9 39·9
Wed	20	2 17	☾ Moon's Last Quarter			9 35·7
Thur	21	8 48	Conjunction of Uranus and Mercury, 0° 43′ N.			9 31·6
Fri	22					9 27·4
Sat	23					9 23·3
Sun	24	4 52	Conjunction of Moon and Jupiter, 2° 15′ N.	2nd Tr. I. 3rd Tr. E. 1st Ec. D. 2nd Sh. E. „ Tr. E.	13 38 13 41 13 54 4 14 12 16 11	9 19·1
Mon	25	3 39 7 47	Conjunction of Moon and Venus, 0° 41′ N. Conjunction of Moon and Mars, 2° 8′ N.	1st Sh. E. „ Tr. E.	13 17 14 16	9 15·0
Tues	26	17 20	Superior Conjunction of Mercury			
Wed	27	1 27 16 0 23 18	Conjunction of Moon and Uranus, 0° 7′ N. Conjunction of Venus and η Geminorum, 0° 9′ N. ● New Moon			9 10·9 9 6·7
Thur	28	2 21	Eclipse of Sun: invisible at Greenwich Conjunction of Moon and Mercury, 0° 8′ N.			9 2·6
Fri	29	3 47 5 44	Conjunction of Mars and Venus, 1° 29′ S. Conjunction of Venus and μ Geminorum, 0° 9′ N.			8 58·5
Sat	30	8 56	Occultation, disappearance of *l* Leonis (5)			8 54·4
Sun	31			3rd Sh. E. 2nd Sh. I. 3rd Tr. I. 1st Ec. D. 2nd Tr. I.	13 46 14 16 15 40 15 47 43 16 23	8 50·3

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CONCERNING THE MEANS OF COMMUNICATION WITH THE PLANETS.

(From *L'Italie.*)

Such is the title of a little work remarkable for the interesting questions which it raises, and the vigorous manner in which the author, M. Ch. Cros, has treated them. After dwelling upon the analogies between the planets and our own globe, and the high probability that the former are inhabited by beings that, however perhaps different in some respects from ourselves, have, nevertheless, with us many points of resemblance, the writer continues:—Are we, putting the question of spirits on one side, the only intelligent and reasonable beings of the creation? Have we not rivals, it may be masters, in those bodies which so much resemble the one that we inhabit? If there are such, what are they? Do they, like ourselves, possess a civilisation? Are they capable of comprehending our sciences, or have they got beyond us? Are we doomed to consider their existence as one of those questions which are continually agitated without ever being settled? Have we, on the contrary, in our hands, any means of convincing ourselves of the presence in the planetary worlds of animated beings, of entering into communication with them, of profiting by that which they know already, and of imparting to them in turn our own stores of knowledge?

Such are the questions to which M. Ch. Cros replies by affirmations supported by arguments which appear to us altogether scientific. Very many practical difficulties may evidently present themselves; but we must avow, however such a project may appear chimerical, that it does not seem to us absolutely impossible.

In the construction of parabolic mirrors immense progress has been made in the present day; we have nearly reached perfection, and those mirrors reflect, almost without loss, the luminous rays which fall on their surface. On the other hand, electricity has furnished us with a source of light of intensity comparable to that of the sun. We are able, therefore, to send to our neighbours signals, which, in order to be perceived, do not demand more perfect instruments than such as are daily used in our observatories.

M. Cros indicates a series of precautions ingeniously contrived in order to prevent our neighbours, the inhabitants of the planets, mistaking our intention of entering into communication with them. He indicates an entire language, sufficiently easy to understand, and which might be gradually perfected in common accord with our new correspondents. We leave to those interested in the matter the pains of seeking in the brochure itself for details more precise and numerous.

It remains to be ascertained whether our neighbours are capable of comprehending our signals; whether, having comprehended them, they are capable of replying to us. May they not be, in regard to us, in a like indifference to that in which we have hitherto been in respect to them? Will they not be arrested as we have been by the singularity, to say no more, of an enterprise like that which we are unfolding?

Here are objections in abundance! But is that a reason for discouraging our advance? Perhaps, says M. Cros, signals have been already made to us which have passed unnoticed. And in support of this hypothesis he appeals to certain unexplained phenomena observed by various astronomers on the disks of the planets.

In all cases, it is not useless that our savants should observe attentively and with the best instruments what is passing on the surface of those bodies. They may thus be enabled to resolve the question, "Do they send signals from the different planets?" If they do, we should apply ourselves

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at once to the search of the means of answering. If they do not, why should we not be the first to begin? Is not the question worth the trouble?

Who can say what a similar correspondence, once established, might reveal to us? Who can say what light it might throw on our sciences? Where would our learning stop? For us the world would no more have limits. Each planet would become, so to say, a relay whence one thought could radiate to the farthest confines of the universe; each planet would charge its neighbour to send to us in its turn its tribute of knowledge. What novel and fruitful activity there would result throughout the entire universe! Will any age be fortunate enough to see such a project realised? It may be so! Human science has not yet said its last word. With the means at our disposal, it does not seem that an absolute impossibility must needs arrest us. Experience alone, in such a matter, can decide whether to will is not to be able.

THE GREAT COMET OF 1744.—Most astronomical students will remember that the great comet of 1744 has pretty generally been spoken of as having had six tails, but the reality of these tails has frequently been doubted. It is satisfactory, however, to find that the truthfulness of Chesaux's observations can be confirmed by a contemporary record. M. Winnecke has recently brought to light some astronomical observations made in Russia, 1726–1747, by the French astronomer De Lisle, from which it appears that De Lisle saw four streamers resembling comet tails in the horizon, converging to a point below the horizon presumed to be the *locus in quo* of the comet. The observations of the two astronomers were not actually contemporaneous to the day, but from a proper comparison of the recorded places it is easy to conclude that the four streamers of De Lisle were four of the six tails observed by Chesaux, and that they did really emanate from the comet, though at the time in question it was below the horizon.

THE SOLAR SPOTS.—I should be glad to have a dozen or so blank diagrams of the sun's disc, if you have them, similar to those of Jupiter, &c. If none exist, I should suggest that it would be worth while to have a few printed off while the sun is such a subject of interest, for observers to mark down the position of spots. The block would cost but a trifle, with a round blank disc, say three inches diameter. It would only be useful with low powers, showing the whole of the sun's face; but the drawings made thus would serve as indices to the representations of particular groups and spots made with higher powers.—G. G.

[We shall take this subject into consideration, but have not yet decided what will be the best size to use. We should like to have the opinion of some of our correspondents on the subject; and also as to the desirability of having lines across the disc, for the better marking the position of the groups. In the mean time, a circle drawn on a piece of stiff paper or card, about three inches in diameter, is about the best arrangement that can be adopted. The contrivance we made use of some years ago, for obtaining the positions of the spots, consisted of a piece of card, of about the above size, with a single cross line +; it was carried by a light framework of wood, attached to the eye end of the telescope, which was driven by clockwork. The eye-piece was a low one, and being pulled a little out of focus, an image of the sun was thrown on the card, which was made to correspond with the diagram. A large circle of cardboard was so fixed upon the telescope as to screen off much of the light and throw a dark shadow all round the bright image of the sun. When the clock was in good order, the image

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of the sun would then remain at rest on the diagram for a considerable period, and the spots were rapidly marked in with a camel's hair pencil and Indian Ink, a light shade for the penumbra and a dark shade for the nucleus. It was possible to do this very readily without disturbing the position of the diagram. Of course, the resulting picture had the spots in a reversed position to what would have been the case if seen either with an erect or inverting eye-piece.—Ed.]

The Observing Astronomical Society. — The Report of Observations made by members during the period from May 7 to June 6, will appear in our next number.

Driving Clocks. — We are informed that Mr. Wears, of Argyle Terrace, Waterford Road, Fulham, makes driving clocks for equatorial telescopes.

Astro-Meteorology.—We have received letters from Mr. Emons, Secretary of the Hackney Scientific Association, and also from Mr. Pratt, with regard to a communication from "Empirici Osor," and our brief note thereon. We must certainly disclaim any intention of insulting Mr. Pratt, whom we have never seen, and we had not the remotest desire to do harm to, or discourage, the Hackney Scientific Association, but quite the contrary. We are glad to learn that Mr. Pratt's labours are appreciated by agriculturists, and that he makes so much by his predictions that he can afford to laugh at strictures such as those of "Empirici Osor." As far as we are concerned, and with regard indeed to most Fellows of the Astronomical Society, &c., our knowledge of astro-meteorology is not sufficient to enable us to cope with such a master of the science as Mr. Pratt appears to be; and we willingly withdraw until Mr. Pratt has sufficiently matured his system to be able to tell us what sort of weather we shall have on any given day. Up to the present time, an experience of a great many years has not discovered to us any person who can make such predictions with a reasonable chance of fulfilment; had it been the case, his fame and fortune would long ago have been assured.

ASTRONOMICAL REGISTER—Subscriptions received by the Editor.

To September 1870.

Cook, James.
Elger, T. G. E.
Hemming, Rev. B. F.
Jackson, Mrs. H. Gwilt.

To December 1870.

Fry, Rev. Dr.
Glover, E.
Monk, Dr.
Noble, Capt. W.
Perry, Rev. J. S.
Prout, Rev. E.
Slater, James.
Squire, H.

To March 1871.

Herschel, Prof. A. S.

June 27, 1870. Subscriptions received after this date in our next.

The Astronomical Register is intended to appear at the commencement of each month; the Subscription (including Postage) is fixed at **Three Shillings** per Quarter, *payable in advance*, by postage stamps or otherwise.

The pages of the *Astronomical Register* are open to all suitable communications. Letters, Articles for insertion, &c., must be sent to the Editor, Mr. S. Gorton, *Parnham House, Pembury Road, Clapton, N.E.*, **not later than the 15th of the month.**

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The Astronomical Register.

No. 92. AUGUST. 1870.

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OBSERVATIONS ON THE PLANET JUPITER.

By Alfred M. Mayer, Ph.D., Professor of Physics and Astronomy in the Lehigh University.

(From the *Franklin Institute Journal* of Feb. 7.)

Every astronomer who, during this fall and winter, has made careful observations of Jupiter, must have remarked the unusual colours of his disc and belts, and the remarkable forms and mutations which the latter have frequently presented.

The night of Jan. 5, 1870, was astronomically perfect, and definition was so clear and steady that the six stars of the trapezium of Orion, and the companion of Sirius, were readily and continuously seen in our refractor of 6 inches aperture, by Alvan Clark & Sons.

Turning the equatorial on Jupiter—as has been my practice every clear night this season—I was struck with the beautiful definition and steady sharpness of outline of the details of his disc, and especially was my attention riveted on a ruddy elliptical line lying just below the S. equatorial belt. When first it attracted my attention it had advanced on the planet to a distance from the E. limb, about half its major axis. This form was

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so remarkable that I was at first distrustful of my observation; but, keeping my eye steadily upon it I perceived that the ellipse became more and more distinct as it advanced towards the centre of the disc, and that it preserved the same distance from the sharp markings of the S. belt which it had when it first caught my eye. I followed this remarkable form until it was about bisected on the W. limb; when it had gradually faded from view.

I am careful in thus minutely stating the circumstances of this observation, for this form (so far as I am aware) has never before been noticed; but so steadily did I see and measure it that I have no fear of having deceived myself as to the accuracy of the observation.

The following are micrometric measures:—

Polar diameter of Jupiter, mean of 4 measures . .	42·48″
From N. pole to first belt „ „ „ . .	13·62″
„ „ „ second belt „ „ „ . .	17·02″
„ „ „ third belt „ „ „ . .	26·4″

The polar diameter from above measures is 42·48″; the American Ephemeris gives 42″.

The irregular, nearly detached masses forming the S. equatorial dark belt, with their streamers pointing in the opposite direction to that of the planet's rotation, present appearances which incline one to imagine them distinct masses of cloud or coloured vapour, instead of openings in a cloudy stratum disclosing the ruddy body of the planet. The elliptical form below the S. belt also favours a similar opinion, a view not generally held, and, I own, difficult to maintain. Sir W. Herschel's explanation of the appearances and nature of the belts is undoubtedly the most satisfactory ever advanced; but we venture to suggest that existing observations on the permanency of position and form of the markings of the belts should be subjected to a careful generalization.

Of the ellipse which appears in the S. bright, cloudy belt, I can offer no explanation. Its major axis to its minor axis is, in its present projection, as 1 to 1·51. If viewed normally (or equatorially) the axes are as 1 to 1·57. Thus, when viewed perpendicularly it still departs largely from a circle-curve. Can we be so bold as to regard it as a great gaseous mass, having its origin in the equatorial regions, and sweeping S. (as with the terrestrial cyclones of the S. hemisphere), and flattened by the rapid rotation of the planet with an equatorial velocity of 450 miles per minute? The ellipse is flatter on the N. than on the S. side, which fact corresponds with the respective angular velocities of these sides of the ellipse.

The irregular and violent changes which have this winter taken place in the S. equatorial belt seem to give this as the latitude of

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origin of this ellipse. On the 8th of January (I read from my observatory note-book), "the S. border of the southern equatorial band has evidently divided into two." On the 9th "the division of the S. belt has increased rapidly." A drawing made on the 21st of January (another superb night) shows the S. division of this belt drifted 8° in latitude to the S. of the band which gave it birth. The S. equatorial belt on this date presented the appearance of irregularly massed cumulous clouds, forming three distinct aggregations with blunted summits. The N. equatorial belt had the appearance of nimbus clouds, from which drooped streamers, which extended to a short distance in the direction opposite to the rotation of the planet. These facts are given to show the changes in this belt; and supposing the S. motion of the new belt uniform, it had a motion of 37′ latitude daily, which equals a daily S. translation of 440 miles.

It is needless to dwell further on the minutiæ of the topography of the planet which the drawings show as they appeared in the 6-inch refractor at 8 h., January 5, 1870, with a magnifying power of 288.

The colour of the planet next demands our attention; and surely no one familiar with the usual tints of the belts and of the general surface can fail to remark the unusual colours which this drawing exhibits.

Jupiter's disc generally is of a light yellow colour crossed by belts of a brownish-grey tint, sometimes, though rarely, approaching a rose colour. Often the brown is entirely wanting, and the belts are merely dull streaks on a light yellow ground.

We can best convey an accurate conception of the colouring seen on the 5th of January by stating the manner in which we tinted a drawing which, when compared repeatedly at the telescope by myself and others, was found correctly to give the colours and their relative intensities.

The whole disc was first washed over with slight tint of yellow. The colour of the region between the equatorial belts was correctly reproduced by pure yellow mixed with crimson-lake, while the two belts N. and the one S. of the equator were obtained by the same combination of colours, with more crimson-lake added, so as to bring the tint to approach a coppery hue. The polar shadings were correctly given by pure yellow with a slight dash of crimson-lake, which tinting was subsequently overlaid with a very thin wash of light lead colour.

A shading shown on the E. limb was distinctly seen, and is referred to the fact that Jupiter was nearing quadrature and the shade was part of the slight phase then observed on the planet, and which has been repeatedly seen by me when the planet is in the neighbourhood of this position. On Feb. 3, it was yet more

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clearly marked, the planet then being about three days past quadrature.

[We are unable to reproduce the fine coloured lithograph of Jupiter which accompanies this paper, and have therefore omitted the explanatory remarks respecting it.—Ed. *Ast. Reg.*]

We have on this subject the following communications:—

Extract from a letter from Professor Mayer *to* Mr. Joseph Gledhill, F.G.S.

The Lehigh University, South Bethlehem,
Pennsylvania, U.S.A.: June 14, 1870.

Sir,—Having seen in the number of the *Astronomical Register* for April 1870, your observations from Nov. 4 to Dec. 31, 1869, on the planet Jupiter, in which you notice and draw the great southern elliptical ring, you will no doubt be pleased to see that both your observations and mine are mutually confirmatory. The paper and plate of the planet which I send you by this mail were published in the *Franklin Institute Journal* for February 1870, and on the plate you will observe the great southern elliptical ring in all its grandeur. Our drawings tally remarkably well. My valued friend, the Rev. Thos. W. Webb, of Hay, S. Wales, writes me that you and I were the only observers who were so fortunate as to see the ellipse.

ALFRED M. MAYER.

From the Rev. T. W. Webb *to the Editor of the* Astronomical Register.

Sir,—I beg to forward for your acceptance a paper,* which has been obligingly placed at my disposal by its author, one of the most accomplished astronomers of the New World. I had been favoured by him on a former occasion with some beautiful photographs of the total solar eclipse of last year, in addition to those which I had the honour of communicating from him to the Astronomical Society, together with the "Report" specially drawn up for the occasion, a document full of valuable and suggestive information. The following extract from one of his letters will not fail greatly to interest your readers:—

"In my recent lectures on astronomy before the Peabody Institute [Baltimore], I succeeded in *reproducing* the eclipse, by the aid of electric-lantern projections of the 42 photographs, on a screen. One plate of totality was painted by hand, by Mr. Gilman, and showed the corona *gloriously*.

"By making the plates of totality *microscope* slides, and using a microscope objective specially calculated to give a flat field on a screen, I succeeded in showing all the minute details of *the protuberances* to an audience of 1,500. Indeed, I obtained the 'caterpillar' protuberance six feet in length, and I assure you it looked frightfully like a huge caterpillar, with two horns issuing from its head, the anterior one terminated with a ball; while its body had all the articulations and corrugations of a caterpillar. By the same process I showed the solar spots, the faculæ, and the mountains on the moon's limb, and, indeed, optically *dissected* the whole eclipse before a large audience."

I remain, Sir, yours truly,
T. W. WEBB.

* The Paper on Jupiter, which commences this number.

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From Mr. John Browning *to the Editor of the* Astronomical Register.

111 Minories: July 4, 1870.

Sir,—I have been greatly pleased by the receipt of a paper from Professor Mayer, in which I find my own observations on the colours of Jupiter corroborated, and also Mr. Gledhill's observations on the curious oval on the northern part of the disc.

This is very encouraging; it shows us clearly that a mistaken notion has been held for some time, that we know all we can expect to know about this the largest of our planets. With large apertures and careful observers, we may hope to gain information respecting Jupiter that will bear some proportion to the knowledge we have lately gained with regard to the physical condition of the Sun.

Yours faithfully,
JOHN BROWNING.

Mr. Gledhill writes us:—"You will see that what Professor Mayer saw for the first time on Jan. 5, 1870, I have seen for months, and that his instrument did not reveal to his delighted gaze several remarkable features seen nightly here."

Halifax: June 28, 1870.

Sir,—Mr. Browning has suggested that the remarkable yellow colour of the equatorial zone of Jupiter, observed during his last presentation, may be connected with the proximity of the maximum of solar spots. Whether the epoch of Mr. Huggins' observation of a similar appearance, "some years ago," will corroborate this suspicion, remains to be seen; but the following extract from a paper by Sir W. Herschel, "On a quintuple belt of Saturn," in the *Phil. Trans.* for 1794, will be of interest in showing that this appearance is at least recurrent, if not periodical:—

"Jan. 18, 1790. I viewed Jupiter with a 40-feet reflector. There were two very dark broad belts, divided by an equatorial zone or space, the colour of which was of a yellow cast. Next to the dark belts, on each side towards the poles, were bright and dark small belts, alternately placed, and continued almost up to the poles, both ways."

If we take Wolf's data for solar spots—1836, the year of a maximum, deducting four periods of 11·2 years each—we arrive at 1791 as a maximum period, which is very near to the date of Sir William's observation.

Permit me to add, in conclusion, that the colour of this part of Jupiter was so obvious with my 9-inch "With-Browning" reflector, that I made the following note without any previous knowledge of its having ever been seen:—

1869. Aug. 28, at 12h. Clear, but unsteady. With power 132 the equatorial cloud-belt of a remarkable yellow tint, like *ochreish*; perhaps mottled, but uncertain through flutter. The adjacent dark belt S. was duplex, as last year, and of a brown colour. N. of the equator the belt was bluish; then N. of that a *very* white band, the most brilliant part of the disc. There were faintish dark streaks N. of this. About midway between the S. duplex belt and the pole there was a pretty conspicuous dark belt.

I am, Sir, yours truly,
T. H. BUFFHAM.

Earith, Hunts: July 12, 1870.

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THE ECLIPSE OF THE MOON ON JULY 12.

This total eclipse of the Moon on Tuesday the 12th of last month, occurring, as it did, at a very favourable time for observation, was well seen in the neighbourhood of London, the evening, although a little misty, being, on the whole, of a very fine character. It was not a phenomenon demanding great telescopic attention, and in general those who provided themselves with instruments of small power saw as much as if they had made use of the greatest optical means. The following extract is from one of our local papers, describing the eclipse as seen by the Rev. J. C. Jackson, principal of the Collegiate School, at Hackney:—

"The eclipse of the Moon on Tuesday the 12th, was visible from the time our satellite rose above the horizon. We watched it from the playground of the Hackney Collegiate School, where the Principal, with his 4-inch telescope, was explaining the phenomenon to some of the boys and numerous friends—several well known members of the Royal Astronomical Society being present. The Moon appeared above the houses partly covered by the penumbra—some of the higher peaks of the giant mountains still appearing bright. It was a fine sight to see the copper-coloured portion in contrast with what was still bright and shining. Then came the dark shadow. Through the telescope not the least interesting views were just before the beginning of the total phase, and the few moments after the last contact with the penumbra. Words can scarcely describe the lovely delicacy of the light as it was almost shut out.

"The distinction of the bright Moon, the penumbra and dark shadow, were best seen as the eclipse began to pass off, at about 11.30. But the most glorious sight of all was reserved for those who continued their astronomical observations to a later hour, when the moon passed from the earth's shadow, bursting into splendour; then the largest stars paled, and any but the very largest went in altogether. Then in the liquid twilight sparkled and flashed forth the glorious pair of planets which now rise so close to each other—Venus and Jupiter. What a marvellous planet is Venus, that even Jupiter seems small beside it! It is well worth anyone's while to sit up till dawn—or, better still, rise a little before the sun—to see the beautiful pair as they mount the soft morning sky."—*Hackney and Kingsland Gazette.*

Mr. G. J. Walker, of Teignmouth, writes:—"I had a grand view of the eclipse last evening. I could not reach the Moon at all from my dome, so was obliged to content myself with the use a of binocular and a sweeper from my study window. The first part I saw while walking by the seacoast with some friends. As the total phase approached, the greenish tint near the illuminated part, with the coppery colour further off from it, was a pretty sight. About 11¼h. the little group, consisting of 53 Sagittarii (about 50′ or so from the Moon's edge) and two other small stars, was plain in the sweeper. Also 51, 52, 165, and 159 Sagittarii. At 11h. 27m. the configurations on the Moon's surface were mostly discernible, and the green tint near the bright part reappeared. At 11h. 57m., when the Moon was more than half uncovered, the shadow looked a very dark green near the lighter portions, and pale red further off. Upon the whole, I did not remark any unusual phenomena.—Clouds deprived me of the view of the occultation of Saturn."

The following is from Mr. Buffham:—

Sir,—After an unpromising day, the evening of the 12th gradually cleared sufficiently to allow a good view. Two points were especially attended to—

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the relative darkness of the different portions of the Moon beneath the earth's shadow, and the colours I received an impression of under different circumstances. For the first a 2·9-in. refractor, power 60, was employed, and the most noticeable of the rapidly changing phenomena were—at least roughly—noted. At 9h. 30m. the Moon was fairly free from the vapour, when I first viewed it with the telescope.

h. m.
9.30. The E. limb is not visible for about 45°: it seems to shade right off, so that the circle appears flattened.
9.45. E. limb still invisible. The principal features of the Moon are fairly made out in the W. hemisphere.
10.13. Nearly all the dark limb is visible, but a little deficient N.E.
10.25. The whole of the darkest limb is now readily visible. Mare Crisium has been visible all the evening.
10.50. Mare Crisium difficult. The Moon is nearly of a uniform duskiness. A lighter crescent lies S.W., and a narrower but brighter one S.E.
10.55. I cannot see M. Crisium.
11. 0. Moon's darkest limb easily seen. Crescents brightening.
11. 7. The general features of the S.E. quadrant are becoming perceptible. A very dark region S. of M. Crisium. A bright patch on N. limb. A star at 8′ distance from the same limb easily seen, and others further N.
11.18. M. Crisium is just perceptible.
11.24. The totality is over; the umbra leaves the bright E. limb to streak out by fits, and seems to waver. M. Crisium very difficult.
11.30. Mare Crisium readily visible. Aristarchus very bright in the shadow.
11.46. Mare Crisium excessively difficult, even when the bright part is out of the field.
11.52. Mare Crisium less difficult. The portion of the Moon beneath the shadow is variegated when the bright part is hidden, but nearly uniform when seen with it.

I made a number of sketches of the darkest patches of the varying eclipse after totality commenced, but I afterwards found that they and their marked changes could all be fairly accounted for by the smaller reflectiveness of the Mares and the altered direction of the *axis* of the shadow relatively to the lunar disc, which was interesting to notice, sweeping round from E. by the N. to W., by the greater darkness in the respective directions. The fading away of the umbra was rather sudden, and no irregularities were noticed in its curved boundary.

As to colours:—

At 9h. 30m. those of the umbra were, with naked eye, dull orange; with 2·9-inch, power 60, dull sky with a warm tinge.

At 10h. 13m. with naked eye, dull ruddy orange; with a 1·6-inch o.g., power 6, nearly the same,—a little darker; with 2·9-inch, the image viewed without an eye-piece, a little browner; the same aperture with power 60—I could not exactly satisfy myself what, but something like dull olive grey or ashy, with a little ruddy tinge occasionally sweeping over.

The naked-eye colour deepened into duller until 10h. 50m., and then gradually brightened and altered until, at 11h. 40m. (one-fourth of the breadth of the Moon having emerged), it was a beautiful deep red copper. At the same time, with the 1·6-inch, rich ruddy tawny; with the 2·9-inch, power 60, ruddy bluish olive, fading away into the eastern side with paler tints; with the same aperture and power 170, paler and somewhat ashy.

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At 12h. 15m. the naked-eye impression was a bright bluish tint at the junction of the umbra and penumbra. The existence of the latter in the clear sky would never have been suspected.

These notes seem to point to the decrease of positive colours with increase of aperture and power. Is the nondescript hue of the deeper part of the umbra in the telescope due to the *super-position* of several tints refracted and transmitted in various degrees by our atmosphere?

I am, Sir, yours truly,
T. H. BUFFHAM.

Earith, Hunts:
July 14, 1870.

THE OCCULTATION OF THE PLANET SATURN ON JULY 10.

This occultation was not well observed in the neighbourhood of London, owing to the cloudy state of the sky. Mr. Talmage, however, of Mr. Barclay's observatory at Leyton, perceived the total disappearance of the planet behind the Moon's limb, the time being 20h. 29m. 56·2s., Leyton sidereal time. Clouds completely hid the Moon at re-appearance.

On September 30 another occultation of this planet will take place, about 6 o'clock in the evening, when, it is to be hoped, the weather will be more favourable for observation.

HOW WE DIDN'T SEE THE OCCULTATION OF SATURN.

On Sunday evening, the 10th of July, about ten o'clock, a stoutish gentleman with a big telescope, and a gentleman of smaller size with a smaller telescope, were to be seen, each shouldering his formidable-looking instrument, in order to place it in position in a private garden in the neighbourhood of London. Although, up to the time mentioned, the sky had been covered with ugly-looking clouds, yet the Moon had just commenced to show itself by glimpses, and, upon the principle of "nothing venture, nothing have," it was determined that the sight of the occultation should not be lost for want of preparation. The stout observer first began preparations by depositing his telescope on the ground and fetching out the stand. As it wanted about three hours to the time of the phenomenon, it was necessary to choose a position where the Moon, which was very low, could be seen when the occultation took place; and as the garden was surrounded with trees, this was a matter of some difficulty.

Experimenting, first in one position, then in another, was not rendered more easy by the fact that the stand was a huge structure, with a heavy iron head, and legs that seemed to have independent movements of their own, frequently refusing to go into the required positions, and threatening at times to bring the whole affair to the ground. However, the problem was at length solved, and the proprietor of the instrument brought out several eye pieces, a dew-cap, &c., and mounted his telescope, which was of four inches aperture, in triumph. The thin observer then got his battery in order. His telescope, of about 3½-inch aperture, was mounted on a vertical and horizontal stand, which was placed on a garden table. He then, at various journeys, brought out a box of eye-pieces, hooks, joints, a lamp, dew-cap, &c.; also a sidereal chronometer, with cards and pencils for making notes. Considering the great temperature at the time, all this labour somewhat exhausted the observers, and they were glad of the assist-

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ance of a lady, who supplied them with chairs and stools. At length the clouds cleared away, and the Moon shone forth, with Saturn, so soon to be "put out," about three diameters of the Moon to the left.

The ragged edge of the Moon was scrutinized and the planet observed. Titan only of the satellites could be seen. After spending some time in looking at the Moon and the planet, an attack on the stars was made, but of a very vague and unsystematic character. Mizar and Alcor, Cor Caroli, and other big doubles, were duly admired, and a variety of little stars examined, in the hope of discovering a new double. Epsilon Boötis was selected as a test for the two telescopes, and both observers were engaged upon it when they declared it had left the field. No wonder—the sky had become covered with clouds! Despair filled each heart. Hope revived, as, at one o'clock in the morning, a break took place in the clouds, and the Moon again appeared. Alas! definition was very queer; but there was Saturn almost close to the Moon. Titan could not be seen. Quickly the lamp was lighted, to show the chronometer, and, with card and pencil in hand, the beats were counted by the lady-assistant, while each observer peered breathless through his instrument. Twelve minutes past one —a fragment of cloud obscured the planet! Thirteen minutes past—Saturn appears again! The counting continues—oh, misery!—at fourteen minutes past one a huge black cloud swallows up both Moon and planet, and renders all chance of seeing the occultation hopeless. Sadly the observers begin to pack up their apparatus; pausing just to give a glance at the zenith and some parts of the sky still clear—giving a look at Alpha Herculis, Gamma Delphini, Gamma Andromedæ, &c., and then retiring to the house to recruit exhausted nature. After a light repast, in which better luck was wished for the eclipse of the Moon on the following Tuesday, they were about to part, when the thin observer, looking out, exclaimed, "Here—here's Venus just rising—and Jupiter!" Nothing would serve the enthusiasm of the stout observer but to get out his telescope again, alas! to be again disappointed; for just as he got it fixed, a mass of cloud again covered the whole sky, and obliterated all objects from view.

CORRESPONDENCE.

N.B.—We do not hold ourselves answerable for any opinions expressed by our correspondents.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

MR. F. BIRD'S SAND-CLOCK.

Sir,—I believe that I shall be doing good service to a large number of practical astronomers by describing a most efficient and economical "driving clock," which has just been invented and brought before the public by Mr. F. Bird, of our town.

The motive power of this "driving clock" is fine sand, which, placed in a tube, is allowed to flow through a small aperture, the size of which is regulated in an exceedingly ingenious manner, and a scale is attached, so that, the best driving speed being once determined, the index can be set to

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the same number when the clock is freshly started. To begin operations, the tube is nearly filled with sand, which, I may say here, will take about four hours to run through; on the sand is placed a flat leaden weight, which of course descends gradually as the sand flows from the tube, and remains at rest when that flow is stopped. A string, fixed to the weight, runs over a pulley on the lid of the tube, and is attached to some part of the telescope near the eye-piece; it is not directly attached, as that would entail a loss both of time and precision, but the cord bends back on itself, and is got to its proper length, and is approximatively tightened, by an arrangement which is used for tent ropes, and which we may call the "coarse adjustment." The junction between the loop of cord and an eye of wire on a part of the telescope, is by means of a most effective little instrument, which may truly be regarded as a "fine adjustment" of the most perfect description, inasmuch as by means of it a star can be centered, or brought up to the wire of the micrometer, with the greatest delicacy. So much for the mechanism, which is very compact and neat in its appearance; and now to see what it will do. My telescope is an equatorial, by Cooke, of 4½-inches aperture, and, being on a tripod stand, an ordinary driving clock, even if I went to the expense, would be applied with difficulty; but the sand-clock, which Mr. F. Bird supplied to me, is portable, like my instrument, and I find it most convenient to have it a few feet away on my left hand, and the attachment made through the "fine adjustment," close beyond the eye-piece, where it is most handy for use. Having found from experiment the best running speed, I set the index to that; bring up the star to the centre of the field by means of the "fine adjustment" (say Arcturus, as it is easily found in the daytime). I find, that with low or moderate powers, that the star remains stationary, or, at most, with a very slight floating movement; but, at all events, it will keep in the centre of the field for a quarter of an hour or more. I now put on deeper and deeper eye-pieces, until I have reached the enormous power (for my instrument) of 630, a power seldom made use of, as, under ordinary circumstances, the star, unrestrained by a clock movement, would seem to travel across the small field at railroad speed; but under the controlling power of the sand-clock I am describing, I not only centre the star with ease, but Arcturus remains in that small field, and with that enormous power, for periods of from 12 to 24 minutes, without my making any further adjustment of any kind. When the close pair σ Coronæ are held captive in this way, with so high a power, their appearance, widely separated, is extremely beautiful.

Now for the other side of the question, and which it is only right and proper to consider. How far will this beautiful "driver" be liable to get out of order? I confess I can only see two causes which could lead to a want of regularity in its movement: the one is *damp sand*, and the other the *presence of extraneous bodies*, which might choke the necessarily small aperture through which the sand flows. But the first evil can be evidently guarded against by keeping this small clock and its accompanying receptacle of sand in the house—in a dry place—when the telescope is not in use; and the cure for the second lies in sifting the sand now and then through a *fine* "gravy strainer," which can be purchased for a shilling.

In summing up the qualities of this ingeniously contrived "driving clock," it may fairly be said, that while its performance is such as to satisfy even the fastidious, the small price at which it appears it can be produced will place it within the reach of even the humblest votary of practical astronomy.

JOHN ANTHONY, M.D. Cantab.

Washwood Heath, near Birmingham:
June 8, 1870.

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GRUITHUISEN'S CITY IN THE MOON.

Sir,—The exceedingly interesting observations by Mr. Whitley of this remarkable lunar object, recorded in the *Astronomical Register*, No. 91, p. 157, calls to mind some remarks not yet made public, which I perused, in July 1868, on this very object. The tracing of terrestrial and lunar analogies must, under any circumstances, contribute to an increase of our knowledge, not only of lunar details, but also of the operation of those agencies which in the past have modified the Moon's surface. Scrope, in his interesting and philosophical work on the "Extinct Volcanoes of Central France," second edition, p. 162, alludes to a terrestrial but similar formation to that of the lunar "Schröter," which it may be best to give in his own words. "The Coiron," he says, "alone beneath the shelter of its basaltic coating, has effectually resisted, and juts out like a huge flattened headland from the margin of the high primary plateau into the southern plain. It has not, however, escaped uninjured. The agents of waste, to which the iron-hardness of basalt itself ultimately yields, have intersected it by numerous transverse ravines, excavated sometimes to a considerable depth through both the volcanic and calcareous strata. They are separated by massive parallel embranchments, which derive from a straight longitudinal axis, exactly in the manner of ribs from the spine. On either side there are as many as eight or nine of these, each crowned by a prodigious tabular load of volcanic products, presenting in its section a vast range of vertical cliffs resting on the secondary limestone strata. The perfect correspondence in position, structure, and dimension of these cappings, as well as their all branching off from the same stem, testify to their having been once united in a single continuous platform." On this passage I have the following note:—"This branching off from a single stem or longitudinal axis in the manner of ribs from the spine is so strikingly illustrative of such formations as 'Schröter,' that it is very difficult to conceive of the lunar object having been formed otherwise than in the same way. Scrope's map of these embranchments, and B. & M.'s drawing of 'Schröter' in the Beiträge, are so exactly the counterparts of each other as to lead to a suspicion that we are on the road to an explanation of such intricate phenomena." Scrope has this interesting passage:—"The almost architectural symmetry resulting on many points from this arrangement, was probably the origin of the fable current among the peasants of the plain below, who still call these rocks 'Les Palais du Roi,' and imagine them to have been raised and inhabited by some giant monarch."

The paucity of our knowledge respecting the *real* nature of the Moon's surface, the slow steps by which we have arrived at our present knowledge of the earth's surface, combined with a consideration of the epochs of hypotheses, as contrasted with those in which a closer adherence to the principle of induction from well classified facts has contributed to more accurate views, together with the difficulties to be overcome in putting forth suggestions that may be opposed to extensively received *theories*, which may, however, be vague and capable of comprehending any amount of suppositious creations, and which, while they offer for a time an explanation of partially observed phenomena, have this disadvantage of stopping further enquiry and retarding the science which they are intended to advance, render it necessary that great caution should be manifested in applying the agencies which have contributed to the formation of the Coiron on the earth to an explanation of the mode in which "Schröter" has been formed on the Moon; nevertheless, the placing in juxtaposition the two formations,

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terrestrial and lunar, cannot fail of drawing attention to their close similarity, whatever may have been the mode of their origin.

I am, Sir, your obedient servant,

Cynthia Villa Observatory, W. R. BIRT.
Walthamstow: July 7, 1870.

THE MOON'S MOTION.

Sir,—There is a painfully confusing letter from "Satellite" on this subject in your last number, in reply to what the writer calls the "sophisms" of Mr. Elvins.

Let Mr. Elvins stand on the edge of the turn-table, as "Satellite" requests, with the compass-box on his head. Mr. E. will face every point of the compass, and the compass-card will also continually point north.

But what does "Satellite" mean by saying, that "either Mr. Elvins or the compass-card must have *turned round itself* (?) during the time of one complete *revolution* of the turn-table"? If he means that Mr. Elvins must have turned round himself, I reply, such a thing is impossible. No man can turn round *himself*—it is a sheer impossibility.

No more can any inanimate object, such as a compass-card or a compass-box, turn round itself; perhaps, by *turning round*, "Satellite" means *rotating*, but he does not say so.

Neither does the turn-table revolve—it rotates. Mr. Elvins, standing on one edge of it, *revolves*. Unless persons writing on this subject will use the terms employed in their proper sense, it is hopeless to expect to settle the question of the moon's rotation.

London: July 12, 1870. D. C.

D'ARREST'S COMET.

EPHEMERIS FOR AUGUST:—

		Berlin Mean Moon. R.A.				N.P.D.	
1870.		h.	m.	s.		°	′
August 1	...	15	40	28	...	87	32
3	...	15	42	54	...	88	18
5	...	15	45	31	...	89	6
7	...	15	48	20	...	89	55
9	...	15	51	21	...	90	44
11	...	15	54	33	...	91	35
13	...	15	57	56	...	92	26
15	...	16	1	31	...	93	18
17	...	16	5	18	...	94	10
19	...	16	9	16	...	95	3
21	...	16	13	26	...	95	57
23	...	16	17	48	...	96	51
25	...	16	22	21	...	97	47
27	...	16	27	7	...	98	40
29	...	16	32	4	...	99	35
31	...	16	37	13	...	100	30

From Mr. G. F. CHAMBERS, Bickley.

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ALLEGED ERRORS IN LOHRMANN'S AND BEER AND MÄDLER'S SELENOGRAPHICAL WORKS.

By W. R. Birt, F.R.A.S.

The phenomena which have been detected in the course of the observations of the spots on the floor of Plato, particularly the intermittent visibility of many of the spots, the recovery of all those which had been observed by earlier selenographers, and the consequent suspicion that several of the apparent omissions by Lohrmann and Beer and Mädler resulted from the omitted objects not having been visible at the time when they observed, renders it important that any differences ascertained to exist between their works and recent photograms and observations should be permanently recorded. It is with this view that I beg to communicate to the pages of the *Astronomical Register* the following instances which have come under my notice.

Lohrmann, Topographie der Sichtbaren der Mondoberfläche, p. 92, speaks of *Linné* as the second crater on the *Mare Serenitatis*, and describes it as very deep. *Beer* and *Mädler* figure it as a crater.

This object is now too well known for me to offer any comment on the above. From the latest observations by Mr. Gledhill, of Mr. Crossley's observatory, Halifax, it appears to have continued in nearly the same state during the last three years, viz. a conical craterlet of about 1″ in diameter, which, shortly after sun-rise upon it, is surrounded by a white cloud.

Lohrmann, in section iv., gives a ridge just W. of *Linné*; it is *continuous*, with a direction nearly N. and S. *Beer* and *Mädler's* delineation differs from *Lohrmann's* in the *discontinuity* of this ridge.

The results of the latter observations of the surroundings of *Linné* will be found in my monogram of the *Mare Serenitatis*.

Lohrmann gives in his section iv. a valley, B, skirting the steep escarpments of the *Appennines* in the neighbourhood of *Hadley*, which communicates with the *Mare Serenitatis* between his deep crater 14 and the N.W. terminating peak of the *Appennines*. This valley is not given by *Beer* and *Mädler*.

On Rutherford's photogram, 1865, March 6, the valley is very distinct, but instead of communicating with the *Mare Serenitatis*, as shown by *Lohrmann*, it is blocked by mountains on which two craters are seen. One appears to be *Lohrmann's* 14.

Lohrmann, in section i., gives a plain, J, with central mountain, which is surrounded by the high mountains 62, 63, and 64 of the same section.

On Rutherford's photogram, 1865, March 6, the appearance of this object is very different, viz. that of a circular hill with a depression of the nature of a crater nearly central. The report of the British Association for the Advancement of Science, 1868, pp. 18, 19, contains all that, at that time, was known relative to it, including the then most recent observations. The surface of the hill appearing as a table-land, a suggestion is offered as to whether *Lohrmann* regarded the table-land as an enclosed plain; a translation of his notice, by the Rev. T. W. Webb, is also given.

1869, January 3, 19h. 40m. to 20h. 20m. G.M.T. Instrument, R. A. S. Sheepshanks' telescope, No. 5, aperture 2·75 inch, power 100. I remark, that the character of this formation, with the central depression and its shadow, was well seen. I also say, that "all observations of the present epoch testify to the different appearance of the hill and crater, as compared with the description of the plain and central mountain by *Lohrmann*."

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Mr. G. J. Walker, of Teignmouth, has very carefully examined the object with his 3·75 achromatic, and his remarks are so much to the purpose that I reproduce them here. Writing under date 1868, November 6, he says: "I cannot but believe you are correct in your remarks, p. 15 [Letter-press IV Aβ], under 1868, May 1. For myself, at least, I rest in the conviction, or something like it, that *Lohrmann's* enclosed plain is the table-land of 11, and his small central mountain the [present] crater 12. There *may* be an illumination which gives a little elevation round that crater, or possibly it has altered since *Lohrmann* and *Beer* and *Mädler* made their observations. [The central mountain is quite absent in both of *Mädler's* maps.] At present, so far from there being any elevation that *I* can see, the reverse would seem to be the case. My means are very moderate, but the appearance of this crater reminds me somewhat of a hole in a bed of sand, as if the edges were rather rounded off than at all raised, or as the cavity when the sand is running out of the minute glass. *Lohrmann* * * speaking of a 'central mountain' makes one slow to conceive [he] was in error; but this mountain is only half of the puzzle, for none of them make mention of a *crater* that I can discover by your pamphlet, and now we have a crater in the only place where it seems possible to locate [*Lohrmann's*] little mountain. Were we sufficiently *up* in selenography to justify such a conjecture, we might put forward the hypothesis, that this mountain has been swallowed up or has sunk into the interior."

These remarks were written more than eighteen months ago, and I believe the object has not been examined since the beginning of 1869. It is consequently desirable that it should be re-examined under different solar altitudes and opposite illuminations.

The following have reference to the British Association Map, area IV Aη, now in the press:—

No. 53. A plain given by *Lohrmann* S.S.W. of his crater B, section i., with a mountain border on the W., on which is situated his crater 51. In *Beer* and *Mädler*, the mountain border and crater are entirely absent, but in De la Rue's photogram, 1858, February 22, more than 25 years later, the W. border is clearly traceable with a very shallow crater on it, in precisely the position indicated by *Lohrmann*, thus testifying to the accuracy of his drawing.

In Rutherford's photogram, 1865, March 6, no trace of the crater exists, but the mountain border and plain are perceptible, although the form of the border is different in the two photograms. A letter on the subject will be found in the *Student*, March 1869, pp. 156, 157.

No. 76. A crater N.N.W. of *Lohrmann's* crater 57, section i., is very plain as given by him, absent in *Beer* and *Mädler*, and faint in Rutherford.

Nos. 79 and 80. Craterlets W. of 76 are given by *Lohrmann*, very distinctly so by *Beer* and *Mädler*. Scarcely perceptible on Rutherford.

THE ASTRONOMICAL KNOWLEDGE OF THE PATAGONIANS is surprising in a people ranking so low in the scale of civilisation. Continually migrating over their arid land, they soon felt the necessity of directing their movements during the day by the position of the sun, during the night by the stars; and thus they gradually learnt to observe the march of the constellations, and to note the times of their appearance and disappearance, giving them names, so as to be able to communicate their observations to each other. Their lively fancy traces in the starry firmament the picture of the Indian's hunting expedition. The Milky Way is the path on which he follows the ostrich; the "Three Kings" are the bolas or balls

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with which he strikes the bird whose feet form the Southern Cross; and the Magellanic Clouds are heaps of its feathers that have been collected by its pursuer. When the Patagonians speak of the direction they intend to follow, from north to south, or from east to west, they always indicate the constellations; so that in these South American plains, as in those of Chaldæa, a similar necessity has led man to lay the first foundations of astronomical knowledge.—Hartwig's *Polar World*, pp. 510-11.

OBJECTION TO THE NEIGHBOURHOOD OF AN OBSERVATORY.—(From a letter from La Comtesse Baldelli, Florence.) Donati paid me a long visit the other day. The subject of conversation (too long for a letter) was the worries and obstacles he had to experience before he could place the first stone of his new observatory, which, by the bye, is to be as near the Torre di Gallo," you remember, as possible. When all objections, and—last, not least—the formalities were exhausted, the inhabitants of the adjoining villas claimed an indemnity at his hands—for what, do you think? "La perdita della libertà!" (the loss of liberty). Donati, astonished, asked in what he caused so grave an accusation? The reply was, "Your telescope will be pointed at our windows whenever you fancy, and the ladies will be annoyed!" It took some explanation to make them comprehend that, however similar to celestial bodies the ladies might be, such telescopes as used at the observatory could not be used towards objects so removed from the heavens *in distance*!

CONTROVERSIAL MATTER.—In answer to "J. D.," we beg to say that no periodical of the nature of the *Astronomical Register* can be carried on free from the occasional appearance of controversial letters in its pages. Some of these controversies get settled by a final and decisive proof being given either on one side or the other; as for instance, that with regard to the "Sun's diameter" in our early numbers, which was disposed of by communications from Mr. Knott and Sir T. Maclean. Others, such as the Moon controversy, upon which we still receive letters, seem hopeless of settlement. We may say that we avoid, as much as possible, controversies on theoretical subjects, and in no case admit communications opposed to known and proved facts—letters written to show that the earth is flat, that the Moon and Sun are the same size, that the Sun is exactly 5,028 miles off, &c. We may add that, the briefer and the more to the point, the more chance communications of a theoretical character have for insertion.

CURIOUS ADDRESS. — We received a month ago a letter addressed outside, "P.M., give this to the Publisher of some Astronomical Journal, London, Old England." This letter, which was from Texas, Ohio, was covered with all sorts of stamps, and marked "not sufficiently addressed;" it found us, however, and we have complied with the request of the writer, to send him a sample copy of our Paper.

THE OBSERVING ASTRONOMICAL SOCIETY.—We are requested to state that this Society entered upon the second year of its existence on July 1. The recent election of officers for the ensuing year has resulted in the re-election of the former President, Treasurer and Secretary, and Committee. The Rev. R. E. Hooppell, M.A., LL.D., F.R.A.S., is the President; Mr. William F. Denning, the Treasurer and Secretary; and the following are members of the Committee:—Messrs. T. P. Barkas, F.G.S.; James Cook; A. W. Blacklock, M.B.; H. Mitchell Whitley, and Albert P. Holden. The Society numbers 46 members, and was formed for the purpose of aiding the spread of practical astronomy.

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THE SOLAR SPOTS.—With reference to the paragraph under this heading in your last number, I find the following the most ready method of mapping sun spots. A piece of cartridge-paper is fixed upon a drawing-board, and a circle is then traced upon it in pencil, to represent the solar disk—I use the brass cap of my object-glass for the purpose, which gives me a circle of exactly 4-in. diameter. Then using a power of 40 in the diagonal eye-piece, I mark on the disk with a faint + the position of each spot as nearly as I can judge it; and if the drawing-board be held just beneath the eye-piece, so that the diagram can be easily viewed and compared with the image as seen in the telescope, a great degree of accuracy may be obtained by any one who can draw correctly. Having thus fixed the *position* of the spots, I next faintly outline their forms, still using the same low power, in order to preserve their relative magnitude to each other and the whole disk. I then substitute a power of 90 to correct the outlines and insert the detail; and afterwards, on the same paper, I make marginal drawings, with a much higher power, of any of the spots that appear deserving of special attention, distinguishing each by a letter corresponding with its place on the disk. I think the expedient suggested by yourself, of receiving the image of the sun on a disk of cardboard, would be very valuable in fixing the *position* of the spots, and perhaps their *outline*; but that it would be difficult to attempt to delineate their details in this way, especially with respect to the relative brightness of different parts. Moreover, with every care in focussing, I never find the image, when projected on a screen, is seen with the same sharpness of definition as when viewed in the telescope. The picture obtained by my method is also a reversed one; but if tracing-paper be used instead of drawing-paper, the picture can afterwards be pasted on cardboard, with its face downwards, and will then give the direct view. I do not think anything would be gained in accuracy by cross lines drawn upon the disk, unless the eye-piece were similarly furnished. A. W. D.

ASTRO-METEOROLOGY.—We have had further communications from Mr. Pratt as to his system of predicting the weather. He says: "I simply advocate the doctrine that the direct action of the planetary bodies upon the earth, when in angular position with it, is the cause of the disturbances known as 'weather phenomena.' Mr. Balfour Stewart and Mr. De la Rue seek to show that the mighty globe of the Sun is in a state of constant disturbance, caused by the influence of Jupiter, Venus, and Mercury, when in certain 30° of angular distance with respect to it, and that the earth's disturbances are intimately connected with it. What is the difference between us, more than that I am merely straining at the gnat while they are swallowing the camel?"

In order to satisfy both Mr. Pratt and those who disagree with him, we give his predictions for June, July, and August, with which the actual weather of these months may be compared.

"JUNE.—Another very favourable month for vegetation, particularly previous to 16th; the latter part more unfavourable, from loss of temperature, humidity, and passing rains, retarding early haymaking.

"JULY.—First half very favourable for hay, maturing the growth produced by previous rain period, and offering promises of fine well-got-up crops to all harvested before 16th to 19th. This will be a period probably for some very high temperature, inducing subsequent thunderstorms and marked decrease of temperature. Close finer.

"AUGUST.—A very dubious month for weather, from the concentration of four positions between the 13th and 17th days, following one of the pluvial

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planet Venus on the 10th. Hence the possibility of a very unfavourable period of prejudice to harvest prospects. Under the circumstances, forecast is somewhat difficult. Should the reaction immediately follow the 10th, from that to the 18th will be of a strong character, with great changes of temperature, leading to a favourable close. But should the strong concentration of influence retard the reaction of Venus, and induce great heat, the change will be of a more violent character, greater contract of temperature hardly recovering till near close."—*Eastern Post*, Feb. 19, 1870.

We must confess ourselves rather mystified by these predictions, which are, perhaps, more easily understood by Mr. Pratt's friends on the Corn Market. We can, however, assure Mr. Pratt that we have no fear of raising a "hornet's nest" about us by noticing his system in our pages, although we consider it as yet not sufficiently exact to be of use to astronomical observers.

On this subject we have received the following from Mr. Lynn:—

Sir,—My name having been brought into your June number *in re* Mr. Empirici Osor and Mr. Pratt, I would wish to say a few words on the point involved. My object is not to defend Mr. Pratt, whom, like yourself, I have never seen, or the "scientific" character of the *British and Foreign Mechanic*, which, like "Empirici Osor," I used formerly to see, but have long ceased to do so.

Your correspondent appears to entertain the same feelings towards the empiric which our old friend Horace does towards the profane multitude, and Mr. Pratt would seem to have addressed you in deprecation of the further term "arceo." But I would ask Empirici Osor how any science, in its infancy, can be anything but empirical. The science to which your pages are more immediately devoted looks proudly down upon its younger sisters, and we, who cultivate it, are too apt to forget the crude guesses of the early astronomers, and still more the vain and delusive attempts at foretelling which even great names amongst them indulged in, and which, indeed, engrossed the term by which our science ought to have been known. Meteorologists labour under no such stigma; and if some of their guesses are crude, others, founded upon considerable masses of observation, will be in all probability considered by posterity as established facts. I am quite certain that "Empirici Osor" will not suspect me of including in this category predictions founded on Jupiter in trine, Venus in sextile, &c.

One thing appears to me to have been forgotten both by most weather prophets and their critics. Effects produced by the celestial bodies upon the earth's atmosphere and upon our weather cannot be local in their character, but must include in their operation the whole, or, at any rate, a very large proportion of the earth, though in particular places they may be concealed by the greater effect of local causes. The correspondence or non-correspondence therefore of a weather prophecy with the event at any particular locality by no means proves that it is founded upon erroneous principles. It is only by comparing the effects at various localities and during long durations of time that correct theories can be arrived at.

I am, Sir, yours faithfully,

Blackheath, July 13, 1870. W. T. LYNN.

While on this subject we may notice a personal matter. In a note appended to the letter of "Empirici Osor" in our June number, we alluded to the odd mixture of subjects in those popular periodicals, the *English*

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Mechanic and the *British and Foreign Mechanic.* We certainly did not intend to be ill-natured, and are free to confess, upon further consideration, that our paragraph might have been expressed in somewhat different language. The *British and Foreign Mechanic* took our remarks much in the spirit in which they were intended. The *English Mechanic* has the following:—

"Mr. R. A. Proctor says:—'The *English Mechanic* will grow to be, if it is not already, the most powerful scientific organ in England. There are some ill-natured remarks about it in the *Astronomical Register* for the current month. It would be utterly absurd to mulct the *English Mechanic* of the best parts of its power by a too rigid exclusion of all but strictly scientific matter.' We noticed the remarks referred to, but took no notice of them, on account of the insignificance of the journal named. It does not circulate as many dozens as the *English Mechanic* circulates thousands. The information it contains is very stale and very dear, as a shilling part contains about as much information as four of our pages."—*English Mechanic, July* 1, 1870.

"Mr. Proctor says:—'Sir,—I cannot wholly agree with you as to the *Astronomical Register.* I have always thought it very plucky and praiseworthy on Mr. Gorton's part to publish a magazine devoted wholly to astronomy; and if there were nothing else to give the *Register* a good standing, the excellent reports of the Royal Astronomical Society's meetings would suffice for the purpose. But I *did* think the attack on the *English Mechanic* uncalled for and ill-considered (I withdraw the word ill-natured; writing in extreme haste, and not meaning my words to be published, I used an ill-chosen expression). I am quite certain that if you were to adopt rigid rules for the exclusion of all subjects except exact science from your correspondence columns, you would soon lose many thousands of your supporters.' We do not withdraw a single word we considered it our duty to write last week, as the small attack on us by the publication referred to was as unprovoked as it was senseless. Of the hundreds of letters of which 'F.R.A.S.' has been kind enough to send us, the only one we thought it advisable not to insert was one written some months since, which indicated in a few sentences the poorness and dearness of the said publication."—*English Mechanic, July* 8, 1870.

To the remarks of the Editor of the *English Mechanic* we need not reply, although, so far as they relate to the "F.R.A.S." mentioned, we must confess they have very much surprised us. We are personally acquainted with many Fellows of the Royal Astronomical Society, and have invariably found them to be influenced by the kindest and most considerate feelings, and we can scarcely believe that any one of them, knowing the circumstances under which the *Register* was started and is still carried on, would have made statements—intended for publication—concerning it which are as untrue as they are ungenerous.

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THE PLANETS FOR AUGUST.

At Transit over the Meridian of Greenwich.

Planets	Date	Right Ascension	Declination	Diameter	Meridian Passage
		h. m. s.	° ′		h. m.
Mercury	1st	9 11 13	+18 6	5″·0	0 31·6
	15th	10 48 41	8 27	5″·4	1 13·7
Venus	1st	6 34 2	+22 26	12″·4	21 50·9
	15th	7 46 10	21 7	11″·6	22 7·8
Jupiter	15th	5 21 42	+22 35½	34″·0	19 43·7
Saturn	1st	17 27 12	−22 4	16″·2	8 46·2
	15th	17 25 30	22 5	15″·8	7 49·5
Neptune	25th	1 22 22	+6 50		15 5·7

Mercury is not favourably situated for observation at the beginning of August, but its position improves during the month, at the close of which the planet may be observed in the evenings, setting after the Sun. It crosses the equator from north to south about the 26th, and passes the meridian one hour and thirty-three minutes after noon on the last day of August.

Venus continues visible before sunrise, and passes the meridian about 10 minutes before 10 o'clock in the morning at the beginning of August, and about half past 10 at the end of the month. The planet is in conjunction with Uranus on the 15th.

Jupiter may now be observed in the mornings, the planet passing the meridian about half past 8 o'clock A.M. at the beginning of the month, and about 10 minutes to 7 at the end of August.

Saturn, though low in altitude, is a conspicuous object in the western sky in the evenings. The planet passes the meridian about a quarter before 9 at the beginning of August, and about a quarter before 7 at the end of the month.

Neptune may now be observed in the east. The planet passes the meridian about half past 2 in the morning at the end of the month.

ASTRONOMICAL REGISTER—Subscriptions received by the Editor.

To June 1870.
Walton, T.
Wolley, Rev. I.

To September 1870.
Buffham, T. H.
Oldfield, W.
Woodman, T. C.

To October 1870.
Shaw, Rev. J.

To December 1870.
Andrews, W.
Gooch, Miss.
Hubbersty, Rev. R. C.
Jefferies, J.
Potter, Rev. T. I.
Shawcross, W.

To June 1871.
Vallance, P.

July 25, 1870. Subscriptions received after this date in our next.

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ASTRONOMICAL OCCURRENCES FOR AUGUST 1870.

DATE		Principal Occurrences		Jupiter's Satellites		Meridian Passage
		h. m.			h. m. s.	h. m. Moon
Mon	1		Sidereal Time at Mean Noon, 8 39 34·1	1st Sh. I. „ Tr. I. „ Sh. E. „ Tr. E.	12 58 14 1 15 12 16 15	— 3 39·0
Tues	2		Meridian passage of the Sun, 6m. 1s. after Mean Noon	2nd Oc. R. 1st Oc. R.	13 31 13 31	4 29·2
Wed	3	20 21	☽ Moon's First Quarter			5 20·0
Thur	4					6 12·1
Fri	5					7 6·1
Sat	6	17 39	Conjunction of Moon and Saturn, 1° 13′ S.			8 2·2
Sun	7			3rd Sh. I.	15 28	8 59·7
Mon	8			1st Sh. I. „ Tr. I.	14 52 16 0	9 57·6
Tues	9	7 17 12 18 12 53	Conjunction of Mercury and Regulus, 10m·6 W. Occultation of 4 Capricorni (6) Reappearance of ditto	1st Ec. D. „ Oc. R. 2nd Oc. R.	12 9 40 15 30 16 18	10 54·3
Wed	10	21 13	○ Full Moon	1st Tr. E.	12 44	11 48·6
Thur	11			3rd Oc. R.	12 28	Saturn — 8 5·5
Fri	12					8 1·5
Sat	13		Saturn's Ring: Major Axis = 39″·4 Minor Axis = 17″·8			7 57·5
Sun	14		Illuminated portion of disk of Venus = 0·868 of Mars = 0·958			7 53·5
Mon	15	15 24	Conjunction of Uranus and Venus, 0° 36′ S.	1st Sh. I.	16 47	7 49·5

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DATE		Principal Occurrences		Jupiter's Satellites		Meridian Passage
		h. m.			h. m. s.	h. m. Saturn
Tues	16		Sidereal Time at Mean Noon, 9 38 42·5	1st Ec. D. 2nd Ec. D.	14 3 10 14 4 1	7 45·5
Wed	17	10 29 11 23	Occultation of μ Ceti (4) Reappearance of ditto	1st Tr. I. „ Sh. I. „ Tr. E.	12 28 13 29 14 42	7 41·5
Thur	18	19 50	☾ Moon's Last Quarter	3rd Ec. R. 1st Oc. R. 2nd Tr. E. 3rd Oc. D. „ Oc. R.	11 37 2 11 56 13 44 14 19 16 43	7 37·5
Fri	19	13 0 13 14 13 58	Near approach of Moon to δ^1 Tauri (4) Occultation of δ^2 Tauri (6) Reappearance of ditto			7 33·5
Sat	20	23 12	Conjunction of Moon and Jupiter, 1° 46′ N.			7 29·5
Sun	21		Meridian Passage of the Sun, 2m. 58s. after Mean Noon			7 25·5
Mon	22					7 21·6
Tues	23	4 35 7 56 23 18	Conjunction of Moon and Mars, 0° 41′ N. Conjunction of Mercury and β Virginis, 9m·4 E. Conjunction of Moon and Uranus, 0° 4′ S.	1st Ec. D. 2nd Ec. D.	15 56 37 16 40 56	7 17·6
Wed	24	7 10	Conjunction of Moon and Venus, 1° 9′ N.	1st Sh. I. „ Tr. I. „ Sh. E. „ Tr. E.	13 9 14 25 15 23 16 40	7 13·7
Thur	25			2nd Sh. I. 3rd Ec. D. 2nd Sh. E. „ Tr. I. 1st Oc. R. 3rd Ec. R. 2nd Tr. E.	11 14 13 29 9 13 46 13 49 13 53 15 37 6 16 24	7 9·7
Fri	26	9 26	● New Moon	1st Tr. E.	11 9	7 5·8
Sat	27			2nd Oc. R.	11 9	7 1·8
Sun	28	1 15	Conjunction of Moon and Mercury, 6° 13′ S.			6 57·9
Mon	29			3rd Tr. E.	11 4	6 54·0
Tues	30					6 50·1
Wed	31	6 23	Conjunction of Uranus and Mars, 0° 25′ N.	1st Sh. I. „ Tr. I.	15 3 16 22	6 46·2

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THE OBSERVING ASTRONOMICAL SOCIETY.

Hon. Sec.—WILLIAM F. DENNING, Ashley Road, Bristol.

Report of Observations made during the period from May 7th to July 6th, 1870, inclusive.

Solar Spots.—Mr. T. W. Backhouse, of Sunderland, reports that in May "there was a remarkable case of a solar spot making part of a revolution round another. It occurred with respect to the two largest spots of a group that was half way across the disc on the 9th. The smaller spot was south of the larger on the 7th at 3h., but preceded it on the 12th at 21h.; the line joining the two spots having rotated through an angle of 80° or 90° in 5¾ days. This movement continued to the 15th, but it would be partly apparent, owing to the group approaching the limb. By that time the larger spot was reduced to the size of the other. I cannot say whether the motion was a curve or a straight line, though it was probably the former; nor can I say which of the spots moved, or whether both did. They were about 22,000 miles apart on the 9th at 3h., but on the 13th at 20h. they were 32,000 miles apart. One spot must therefore have moved relatively to the other about 34,000 miles in 4¾ days, or at the rate of 300 miles per hour."

Mr. Thomas G. E. Elger writes: "The sun-spots observed during June were, with the exception of one group, small and devoid of interest when compared with those seen in April and May. The largest spots were confined to the sun's northern hemisphere. Between the 8th and 15th the spots were all small; on the latter date there were only two groups on the disc, and these were insignificant. On the 19th a very remarkable spot was observed; it formed the *preceding* number of a large scattered group 2′52″ in length; its penumbra measured about 1′10″ in greatest diameter. At 10 A.M. an isolated mass of light, intensely bright, was remarked on the nucleus; this, at 2 P.M., formed a bridge connecting adjacent sides of the umbra. The nucleus of this was very uneven in colour. At 5h. 15m. P.M. on the 19th, the central position was noted as brown and the border as black, and on subsequent dates the variety of tint was still more marked. At 7 A.M. on the 21st, when the penumbra showed evident signs of cyclonic action, not more than half the area of the nucleus was black, the remainder was made up of patches of various shades of brown. The group disappeared at the limb on the 27th."

Mr. H. M. Whitley, of Truro, noticed on June 21 one very large, round, and well-defined spot on the sun's disc. "The penumbra was invaded by two tongues of faculæ for a short distance, and in the centre of the umbra there was a light patch."

The Rev. S. J. Johnson, of Crediton, has also frequently examined the sun's disc, and says that the spots have recently been very large and interesting.

Lunar Observations.—Mr. John Birmingham reports that on June 6 he "saw a very marked central depression in the white spot of Linné, though the terminator was so far away as the boundary between the *Mare* and the *Palus Putredinus*. The depression was very shallow and rather east of the centre of the white spot."

Mr. H. Michell Whitley has forwarded me numerous and interesting observations of lunar objects, made with a 6½-in. silvered glass reflector. These have been sent to Mr. W. R. Birt.

Saturn.—Mr. H. Michell Whitley sends the following:—"June 21, 11h. to 13h. Air very unsteady, but after midnight definition better; power, 250, 6½-in. reflector.—*The Ball.* Duller yellow than rings. Equatorial zone yellow. N. of this a pale red belt, and another further N. again, towards

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pole, much fainter and about midway. Pole of planet, bluish grey. Edges of ball slightly shaded. No other spots or markings.—*Ring A.* Inferior in brightness to B, colour pale yellow. No subdivisions or markings on it. *Ball's division.* Traced all round. Widest and darkest, if at all, in W. ansa. Sharply defined. In colour it was not so black as the sky, but deeper than the crape ring across ball. Colour dusky.—*Ring B.* This ring was very bright for a short distance from its outer edge, which was sharply defined. Colour gradually deepens and light fades towards inner edge. Outer edge, lemon yellow; duller and deeper yellow inwards. Strongly suspected to be streaky, but no actual subdivisions seen. No line of light on inner edge of ring which was not sharply defined.—*Ring C*, or *Crape Ring.* Very delicate colour, dusky purple. I could, with care, as a very fine object, trace the edge of the globe through it up to ring B. Equally distinct in E. and W. ansæ. No markings of any kind upon it. June 28, 10h. to 11h. 15m., power, 250: definition very fluttering; north equatorial ruddy belt very distinct; equatorial yellow band brightest part of the planet. Between the north equatorial ruddy belt and north pole lay one or perhaps more very faint ruddy bands. Pole: pale bluish grey, no other markings. The crape ring very dark and distinct across the belt. July 2, 10h.: a glimpse observation; definition very sharp; power, 250. The two belts before mentioned very much plainer and darker than on June 21 and 28, and not of such a ruddy hue."

A New Red Star.—Mr. John Birmingham writes:—"On May 26 I observed a very remarkable full-coloured ruby star, of 8·5 mag., in Cygnus. Its position makes it identical with 3077, zone + 47° of Argelander; but it does not appear to have been seen as a red star before, as it is not in Schjellerup's catalogue (*Astr. Nachr.* No. 1591), nor has it been mentioned in any other place that I am aware of. Position for 1855, 20h. 15m. 10s. and + 47° 25′·8. There is a blueish-white star of 8·3 mag. quite near it."

Meteors.—Mr. George J. Walker, of Teignmouth, writes: "A splendid meteor traversed the greater part of the sky last night (June 24). It was much larger and brighter than Venus, and of a blue colour. I think it appeared a little to the right of Altair, and passed near Vega and on to the Pointers in Ursa Major. It had a magnificent train, and I think must have traversed an arc of about 120°. I could not follow it to the northern horizon on account of a hill and trees intervening. The time of its appearance, as well as I could make out from my watch, was 11h. 13m., G.M.T., and it may have been seven or eight seconds making its sweep across the horizon. I did not hear any sound with it."

Mr. H. M. Whitley observed a meteor on June 29, 11h. 30m. It was of the second magnitude, had no train, and was of a pale yellow colour. Its velocity was very great—15° in ½″.

Winnecke's Comet.—Mr. George J. Walker examined this object on June 5, 6, and 7. He says that it presented the appearance of a tolerably bright nebula. On the 6th, at 2h. A.M., it was in the same field as 68 Piscium. It appeared then a very faint object. Mr. Walker also looked for D'Arrest's comet on June 5, but could see nothing of it. Mr. John Birmingham frequently looked for the latter object, but up to June 4th could not find it.

Occultation.—Mr. G. J. Walker reports: "I observed the immersion of θ Libræ on June 11, at 9h. 27m. 55·6s. G.M.T.; time probably reliable to a second or two. The star disappeared very close to the bright edge of the moon. Parallax had an unusually large effect on the time of the occultation approximately given at 9h. 43m. in the *Nautical Almanack.* Power used, 60."

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REPORT OF THE PROCEEDINGS OF THE OBSERVING ASTRONOMICAL SOCIETY DURING THE YEAR, from July 1st, 1869, to July 1st, 1870. It will contain particulars of the Observations of Astronomical Objects and Phenomena by the Members, and will include a paper by Mr. W. R. Birt, F.R.A.S., on "Hints and Suggestions on the Observation of Lunar Objects." The volume will also contain a List of the Members of the Society on August 1st.

Applications for copies should be made to Mr. William F. Denning, Hon. Sec., Ashley Road, Bristol.

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The pages of the *Astronomical Register* are open to all suitable communications. Letters, Articles for insertion, &c., must be sent to the Editor, Mr. S. Gorton, *Parnham House, Pembury Road, Clapton, N.E.*, **not later than the 15th of the month.**

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The Astronomical Register.

No. 93. SEPTEMBER. 1870.

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APPENDIX—"On the Primeval Symbolism of the Great Bear and Orion."—By G. J. WALKER.

THE LUNAR CRATERS ARISTARCHUS AND HERODOTUS.

BY H. MICHELL WHITLEY.

The brilliant crater Aristarchus and its companion Herodotus have always been favourite subjects for study to observers of the lunar surface. Their first appearance on the terminator, and their altered aspect as the sun slowly rises above their horizon and gradually attains its meridian altitude, ever present features of interest; and it is with the view of showing these successive appearances that I have embodied in the following table the various observations which I have at different times made on these craters. The instrument chiefly used has been a Browning-With reflector of $6\frac{1}{2}$ inches aperture, but I have also employed refractors with $3\frac{3}{4}$ and 3-inch object glasses respectively.

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The observations are arranged in the table in order of solar altitudes, from sunrise to meridian passage.

OBSERVATIONS OF ARISTARCHUS.

Morning Illumination.

No.	Date	G. M. T.	Sun's Alt.	Character
			° °	
1	1870. July 9	9· 0	0 – 6	Crater, ground S. roughened with ridges.
2	1870. Jan. 14	5·30	6–12	Crater with brilliant ring; from N. end brush of light to S. of Herodotus.
3	1870. May 13	8·30	12–18	Bright crater ring, with central hill; brush of light to Herodotus spreading out beyond.
4	1870. Jan. 15	7· 0	18–24	Bright crater; brush of light, but little light N. of it.
5	1870. July 11	11·30	18–24	Brilliant white spot; faint brush of light to Herodotus.
6	1870. May 14	8· 0	24–30	Bright crater ring, central hill, and brush of light.
7	1869. Aug. 22	10· 0	36–42	Bright spot, brush from N. end to S. of Herodotus.
8	1869. May 26	10· 0	42–48	Brilliant spot; no ring; brush to and beyond Herodotus.
9	1870. July 14	11· 0	48–54	Ditto ditto.
10	1870. July 16	12· 0	65–68	Bright white patch, defining crater's outline; faint brush towards Herodotus.

From these observations it will be seen that at sunrise the crater Aristarchus has, on the south, a tract roughened with ridges; but when the sun attains an altitude of about 6° a very curious brush of light makes its appearance; as this streak is constantly visible (although varying slightly in form) from the time the sun attains this altitude to meridian passage (and probably beyond it, but I have not observed the crater during evening illumination), it requires to be described rather minutely.

It starts from the east side of Aristarchus, where it is nearly as broad generally as the crater itself, and runs to the south end of Herodotus. Here it is gathered into a much narrower space; but after crossing the outer south slope of this crater, it expands like

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a fan and thus gradually dies away, the whole streak usually somewhat resembling in shape a rude hour-glass.

The brilliant ring of Aristarchus, I find, can be distinguished from the bright interior of the crater until the sun's altitude equals 36°, when it can be no longer discerned, and Aristarchus appears as a brilliant spot defining the crater's outline, which I can readily trace under all angles of illumination, the only time when any difficulty is found being at the period of the sun's meridian passage; but even here, though the light spot fades gradually into the before-mentioned streak, with a little attention the crater's form can be fairly made out.

The outline of Aristarchus, when fully illuminated, does not seem to have been traced at times by some observers; thus, in the *Student*, Vol III., p. 190, is a paper by Mr. Browning on this crater, in which he says: "The details of Copernicus, when fully illuminated, can be well made out with a moderately powerful telescope; while in the case of Aristarchus the very form is so completely changed that it can no longer be recognised. In addition to the loss of definition under full illumination caused by its high reflective power, Aristarchus seems to alter its form under different angles of illumination more than any other lunar crater, not excepting even Linné"; and he describes Aristarchus, when fully illuminated, as "a nebulous patch of enormously increased diameter and of a totally different form. From the central peaks bright lines, like the ridges of hills, reach as far as Herodotus, to the side of which Aristarchus now appears to extend."

It will be at once seen that during the time of my observations Aristarchus has not presented the appearance described by Mr. Browning, but that I have always been able to trace the outline of the crater, even during the sun's meridian passage—a point to which I directed special attention. What, however, is this curious white brush that is so persistently visible after the sun has attained an altitude of 6°?

My first impression was that it was a lava stream, which had overflowed the lip of the crater, but its passing up and across the outer slope of Herodotus is inconsistent with this theory. One thing with respect to it seems clear—that it proceeds wholly from Aristarchus, and is of a date posterior to Herodotus, which crater differs totally from Aristarchus, in showing a bright rim with a gray interior during high illumination. The brush cannot, again, be a glaze on a smooth surface, as it is visible under such different angles of illumination. It may be a glaze on a roughened surface, or it may be a train of ashes ejected from the crater; but the distance to which it extends in one direction presents a difficulty to the acceptance of this supposition.

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I do not see that any definite reply to the question can at present be given, but the subject merits attention, and the craters would well repay an extensive and strict scrutiny, under every angle of illumination, especially as to the formation of the ground over which this light streak passes, which examination would not fail eventually to add to our stock of knowledge of the white and glistening portions of the Moon's surface.

THE OBSERVATORY OF THE LATE SIR JAMES SOUTH.

A short notice on page 247 of our volume for 1867 informed our readers of the death of this once celebrated astronomer; and it was with a degree of sadness that we attended at Kensington on the 4th of August, and witnessed the dispersion under the auctioneer's hammer of that fine and curious collection of astronomical instruments which it had been the business and pleasure of his life to accumulate and experiment with. Apart from the interest connected with the observatory itself, it is melancholy to note the trifling sums at which instruments are sold which have cost their original possessor an untold amount of both money and thought; but what remedy is there? Few care to purchase what is to some extent obsolete, and the rising generation in general care little for mementos of those who have passed away long before their time. The fine house and grounds known as the Observatory, Kensington, situated at Campden Hill, were purchased by Sir James (then Mr.) South in 1826, with a view to the erection of as good an observatory as liberal means and complete knowledge of the subject would enable him to accomplish. Mr. South had had his attention turned towards astronomy in early life, and commenced his observations with a six-inch Gregorian reflector. In the year 1816 he erected an observatory at his house in Blackman Street in the Borough, and furnished it with two telescopes—a Dollond of 3¾ inches aperture, which had been equatorially mounted by Captain Huddart, and another telescope of 5 inches aperture. He also set up a transit instrument by Troughton, constructed on the model of that supplied to the Royal Observatory, Greenwich, of 4 inches aperture, and 7 feet focal length. Here, in conjunction with Sir John Herschel, he commenced and completed that celebrated catalogue of 380 stars which was presented to the Royal Society and printed by Government in 1824, and for which its authors received the gold medal of the Royal Astronomical Society. After this, Mr. South removed the

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larger telescope to the vicinity of Paris, in order to obtain a better atmosphere for delicate observations than that yielded by the neighbourhood of the Borough; and here he continued observing until the close of 1825, completing a second catalogue of stars which was printed in the following year. For his labours in this way, and on other subjects of research connected with astronomy, he received the Copley medal.

When Mr. South removed to Kensington, he furnished his new observatory, which consisted of a small equatorial room, a transit room, and a room for an altitude circle, with the instruments removed from the Borough; and in the last-mentioned room he placed the famous transit circle used by Groombridge in the formation of his catalogue, and a clock presented to him by the King of Denmark. He also prepared to erect a magnificent equatorial, the object-glass for which, by Cauchoix, he purchased in Paris. A most complete and splendid dome was constructed from the designs of Brunel, at a cost, we are informed, of about 1,800*l.*, and a mounting on the Sissons plan was made by Troughton & Simms. Unfortunately this instrument, which bade fair to be one of the finest and most effective ever established, was never carried to completion. Sir James (who was knighted in 1831) was dissatisfied with the mounting, which did not come up to his idea of what an equatorial for so large a telescope should be. He refused to pay the makers, who brought an action against him, which he lost; and this caused him such bitter disappointment that he had the mounting entirely broken to pieces and sold for old metal. For many years he retained the 12-inch object-glass, but at length presented it to the Dublin Observatory in 1862.*

After this unfortunate transaction, Sir James South to some extent gave up the pursuit of astronomy and confined himself to experiments with clocks, pendulums, and matters of a like nature. He retained his observatory and instruments, but did little work with them, allowing them to materially suffer from disuse. For some years before his death, which took place on the 19th October 1867, he had been afflicted with almost complete deafness, which to a great extent prevented him from communicating with the scientific world.

On the day of the sale but few comparatively of the astronomical public assembled, and the bidders who met under the large equatorial dome consisted for the most part of brokers and trading opticians. In the grounds outside, where the grass had

* Of this object-glass it is related that when Sir James first met with it in Paris he had it turned upon a bright star as a test. He only looked at the image of the star once, and immediately agreed to the large price—about one thousand pounds—demanded by the makers.

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flourished neglected, and the fruit-trees seemed to have borne their produce where there were none to gather, we saw the large 12-foot refractor, of $7\frac{3}{4}$ inches aperture, which we believe was at one time erected above the house in Blackman Street. This telescope was mounted on a huge frame, with ladders and pullies somewhat resembling the mounting of Sir William Herschel's large reflectors. There were also a curious collection of telescope stands of all sorts, with huge flights of wooden steps constructed for the purpose of ascending to eye-pieces of terrible altitude. Looking over the instruments within the building, most of which bore some label of description in Sir James South's writing, we came across two which struck us. In one of the reflecting telescope-cases was a paper stating that the instrument was made by a man after he had become totally blind! Outside another box were words to this effect—"Another of my sad, sad failures: what will the cost of it all amount to?" We have said that the prices realised were very low: they might have been better if the sale had been better arranged. When we point out that in many cases a telescope was knocked down to one person without eye-pieces or case, that its eye-pieces mixed up with odds and ends of all sorts were sold to another, and that its case filled with old rubbish was disposed of for a mere trifle to a third, it is evident that justice was done neither to seller nor purchaser. The auctioneer truly stated that he knew nothing about the things, but surely it would have been possible to have employed some one before the sale who, practically acquainted with scientific instruments, could have fitted the eye-pieces to the respective telescopes. Moreover, no day for viewing the instruments was named in the catalogue, so that few present knew what the lots were for which they were called upon to bid. The following were the prices at which the principal instruments were knocked down:—

Achromatic Telescopes.

Lot.		£	s.	d.
11.	Telescope, 3-in. aperture, 5-ft. focus, and stand	3	3	0
20.	Ditto, 3-in. aperture, 3-ft. focus, on table-stand with finder	7	1	0
36.	Ditto, $3\frac{3}{4}$-in. aperture, 5-ft. focus, on stand	13	0	0
63.	Ditto, 5-in. aperture, 5-ft. 8-in. focus, on equatorial stand	6	10	0

(Of these four telescopes, none had any eyepieces or cases.)

Transit Instruments, &c.

10.	A transit instrument by Dollond, $2\frac{3}{4}$-in. aperture, $3\frac{1}{2}$-ft. focus, 10-in. circle, on iron stand	5	0	0
26.	Portable transit instrument in case, telescope, 20-in. focus, 18-in. circle divided on silver, with 2 reading microscopes	13	10	0
41.	Reflecting circle, 12-in. diameter, by Troughton	6	0	0
43.	Theodolite, 12-in. by Troughton, with stand	5	10	0

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		£	s.	d.
	Reflecting Telescopes.			
31.	Reflecting telescope, 15-in. diameter, 5-ft. focus, mahogany tube, eyepieces, &c.	15	0	0
35.	Large reflecting telescope, with wooden tube	8	0	0
40.	Reflecting telescope, in case, complete	6	0	0
45.	Small reflector	1	7	0
	Clocks.			
53.	Astronomical clock by Pennington, with mercurial pendulum	14	0	0
55.	Ditto by Earnshaw, ditto	13	0	0
56*	Ditto by Molyneux, ditto	13	10	0
57.	Ditto by Pennington, ditto	13	0	0
60.	Ditto by Grimaldi & Johnson, with compensation pendulum	12	0	0
56.	Journeyman clock by Molyneux	6	0	0
59.	Ditto ditto	5	0	0
61.	Ditto ditto	5	10	0
62.	Ditto by Arnold & Dent	5	10	0
44.	Journeyman seconds chronometer by Pennington	0	14	0
33.	Large pendulum, with 80 lbs. of mercury.	7	0	0
	Micrometers, &c.			
50.	Micrometer by Dollond	6	6	0
74.	Four micrometers, and other apparatus	7	7	0
	Upwards of one hundred eyepieces, and other apparatus, in eight lots.			
79.	Parts of a large equatorial mounting, viz. Polar axis and two circles, with cradle, and a large transit telescope	2	10	0
21.	Large wooden stand for equatorial mounting	1	7	0
27.	Parts of the same mounting, in box	4	8	0
28.	Round tin box containing a floating collimator	0	17	0
	Two observing chairs, with machinery and stuffed cushions.	3	10	0
48.	A coloured object-glass, 4¾-in. aperture	2	10	0
	The Observatory Instruments.			
52.	The transit circle by Troughton, 3¾-in. aperture, 5-ft. focus, two circles, 4-ft. diameter, each with six reading microscopes, with reflecting apparatus, eyepieces, levels, stone piers and foundation, reversing crane and pullies, horizon troughs, deal steps, &c. &c.	50	0	0
58.	The transit instrument by Troughton, 4-in. aperture, 7-ft. focus, stone piers and foundation, levels, eyepieces, reflecting apparatus, reversing apparatus, &c.	22	0	0
54.	The 5-ft. equatorial by Dollond, 4½-in. aperture, 22-in. hour circle, 4½-ft. declination circle, two microscopes, micrometer, eyepieces, &c., with the framework, stone piers, also the copper dome and roof	26	0	0
	(This instrument was employed for the Herschel & South Star Observations; an engraving of it will be found in the Philosophical Transactions. The framework of the Polar axis is constructed of iron plate).			
100.	Large refractor, aperture 7¾-in., focal length 12-ft. Erected in the grounds, with timber framing of stand, ladders, pullies, &c., on stone circular curb	24	0	0

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CORRESPONDENCE.

N.B.—We do not hold ourselves answerable for any opinions expressed by our correspondents.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

THE LATE LUNAR ECLIPSE.

Sir,—Atmospheric conditions would appear to have been more favourable in other parts of England than in Sussex on the night of the 12th of July, inasmuch as the Moon was invisible here, from cloud, until some time after the totality of the Eclipse had passed: in fact, one-third of her disc was clear before anything could be seen. The shadow of the earth appeared to me to be *browner* than I remember to have seen it before. The lunar detail was strikingly visible through it.

My more immediate object, however, in writing is to enquire if any of your readers attempted to examine the shadow spectroscopically. I did myself, but failed to obtain anything worthy of the name of a spectrum, owing to the exceeding feebleness of the light. As is pretty well known, the aperture of my refractor is only 4·2 inches, and this is quite the minimum with which a spectroscope can be employed at all. Now, however, that gigantic instruments are so common others may have been more fortunate, because better provided, than I was; and I am rather curious to know whether any result as to the spectrum of the obscured part of our satellite was arrived at.

I am, Sir, your very obedient servant,

Forest Lodge, Maresfield, Sussex: WILLIAM NOBLE.

August 2, 1870.

THE PLANET JUPITER.

Sir,—The following notes on the changes in the physical aspect of Jupiter since his last apparition may possess some interest for some of your readers.

Streak No. 1 is rarely seen, and then it is a fainter object than it was six months ago.

Streak No. 2 is, in some parts, both fainter and narrower than it was. It is also more rugged.

Streak No. 5 is present or absent, as before, according to face of planet turned towards us. When it extends quite across the disc it is seen to have increased in thickness, and in distance from Streak 4. When that portion is seen which precedes the full, broad portion, it is faint, lies nearer No. 4, and is much broken.

Streak No. 6 is seen well almost always. It sometimes appears much curved: at others quite straight, or very nearly so. The "break" in No. 6 has not yet been detected, nor has the fine Southern ellipse been seen here.

Zone *e* seems narrower.

Zone *c* has the usual character as regards colour and markings, the festoons having been seen once quite well. A bright zone runs along the central line of this dark zone *c*.

The region about the South Pole is much darker than it was.

I am, Sir, yours, &c.,

Halifax: JOSEPH GLEDHILL, F.G.S., F.M.S.

Aug. 12, 1870.

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SOLAR SPOTS.

Sir,—As a matter of course, numerous reports of large solar spots have lately appeared in the *Register*, but in general they contain no notice of one feature, which its discoverer believes to be an important distinction; at any rate, it is of some interest to the observer. I allude to Dawes's nucleus, the black spots in the dark umbra of a solar *macula*. My first view of a nucleus several years ago was quite unexpected, as I supposed it to be very seldom within the reach of a 2·9-inch refractor, and was, therefore, not looking for it. A similar fortune seems to have been Mr. Birmingham's (*Reg.* 1869, Aug.), and the fact of his independently proposing the terms "nucleus," "umbra," and "penumbra"—the same as were employed by Mr. Dawes many years ago to distinguish the various parts of the spots—indicates their suitability, and will probably claim the attention of those who desire to give unequivocal descriptions of these wonderful phenomena. It is not long since a careful observer and correspondent used the words "nucleus" and "umbra" interchangeably in the same sentence; and the former term is too often used where, evidently, only the latter is meant.

With the above-mentioned telescope, and power 74, I have, since my first view, seldom seen a pretty large spot without detecting the nucleus; but when the air would bear it a higher power was an advantage. Very often there are several nuclei in one spot; the umbra in that case has usually been of such a form as would result from the conjunction of as many roundish umbræ as there were nuclei, all enclosed in one penumbra. As many as 10 nuclei have been detected on the Sun in one observation. In the large and very remarkable spot near the centre of the disc on the 20th June I found 5 nuclei with power 74.

There is an erratum in my letter on page 175, line 12 from the bottom. *For* dull sky, *read* dull ashy.

I am, Sir, yours truly,
T. H. BUFFHAM.

Earith, Hunts.
Aug. 10, 1870.

Lectures on Electrical Phenomena and Theories. By John Tyndall, LL.D., F.R.S. London: Longmans.

The few remarks we made in our number for July on the reprint of Professor Tyndall's *Lectures on Light* are equally applicable to the present work. These seven lectures on Electricity were delivered at the Royal Institution during the months of April, May, and June in the present year, and are here reproduced in a convenient form for the convenience of persons interested in education.

Heat a Mode of Motion. By John Tyndall, LL.D., F.R.S. London: Longmans.

We have before us the fourth edition of this celebrated work by Dr. Tyndall, which attracted such great attention on its first appearance in 1863. The subject of Heat, thermometric and radiant, is treated in a most comprehensive manner, and in a way which cannot fail to be attractive, both to those who study deeply as well as to others who read for amusement only. It is scarcely necessary for us to point out in how many ways heat is in connection with astronomy—the earth's motion, the theory of the Sun, lunar radiation, the tides,—in short it is impossible to enumerate the variety of instances in which, as a mode of motion, it enters into the various phenomena of our favourite science. Although not strictly an astronomical

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work, this is a book which all astronomers ought to possess; and while it is a thoroughly scientific treatise, it is written in a most attractive manner, and places the subject before the reader in such a way that it is scarcely possible to take it up without reading it entirely through. Some possess the wonderful art of making seemingly dry subjects fascinating, and Dr. Tyndall is one of these to a large extent.

STRANGE METEORITE.—The following account of a strange meteor seen by J. S. Holden, Esq., of Glenarm, Ireland, will be of interest to our readers:—"On the evening of the 15th, at about half-past eight o'clock, a bright meteor appeared in the N.W. part of the heavens, corresponding to the constellation 'Canes Venatici,' at that hour.

"Its first appearance was that of a first magnitude star, then it assumed a comet form, moving in a W. direction, but no sooner shaped than it suddenly resolved itself into a white opaque ring of cloud, well defined and luminous; this gradually expanded into a larger circle, and from the opposite side to which it was moving a tail was ejected, curving earthwards. In five minutes the whole was but a fleecy wreath of cloud reflecting the fading rays of the distant sunset.

"There is every probability that this phenomenon was caused by a visit of one of the August meteorites, which entering our atmosphere became incandescent from the friction and heat. This new condition of things overcame its already weakened molecular cohesion, causing its abrupt disintegration or bursting into a cloud of attenuated matter, which in its fall and distribution through the air assumed the appearances observed.

"Similar phenomena have been recorded as attending the death of a meteorite."

A LARGE SILVERED GLASS REFLECTOR is exhibited at the Workmen's International Exhibition at the Agricultural Hall, by Mr. T. W. Bush, Baker, 102 Canal Street, Nottingham. The mirror is thirteen inches in diameter; the focal length about ten feet. The tube is open, except for about two feet where it is fixed to the declination axis, and is composed of a stout framework of iron rods. The hour and declination circles are large and easy to read. The slow movement in right ascension and declination is given by means of sectors, worked by endless screws. The prism by means of which the rays are conveyed to the eye-piece is held by three thin strips of metal upon Mr. Browning's plan. The mounting on the whole is simple and massive, and looks as if intended for work.

THE EDINBURGH OBSERVATORY.—Professor Piazzi Smyth's Report of the 29th June last has been forwarded to us. It contains an elaborate investigation into the causes of the fluctuations of the piers of the transit instruments, with an account of the various experiments made to ascertain the reasons of the unsteadiness, and arrives finally at the determination that the stone employed in their construction is at fault, owing to its great expansion and contraction from variations of temperature. The proposed new equatorial next demanded attention, and it was to be regretted that, notwithstanding repeated applications to, and answers received from, Government on the subject, this important want had not yet been supplied. It seemed that the size of the instrument was restricted by architectural considerations, which only allowed a dome of certain dimensions, and consequently it was under consideration whether a reflector, as of shorter length, with the same aperture as an equally powerful refractor, should not be decided on. The Colour-Cycle of 95 Herculis; Clocks; Time Signals;

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and Meteorological Work, were the remaining subjects alluded to in the Report; Professor Smyth adding that, in answer to many enquiries, he had to state that he was not going to Spain to view the Eclipse of December next. The Report concluded with some particulars as to the Great Pyramid and the Observatory of Tycho Brahe.

ASTRONOMY IN THE ARCTIC REGIONS.

[From the Diary of Dr. Kane, in Rensselaev Bay, lat. 78° 38′, almost as far north as the most northern extremity of Spitzbergen, and in a far more rigorous climate.]

1853, September 10.— + 14° F.—The birds have left. The sea-swallows which abounded when we first reached here, and even the young burgomasters that lingered after them, have all taken their departure for the south. The long "night in which no man can work" is close at hand; in another month we shall lose the sun. Astronomically he should disappear on October 24th, if our horizon were free; but it is obstructed by a mountain ridge, and, making all allowance for refraction, we cannot count on seeing him after the 10th.

September 11.—The long staring day, which has clung to us for more than two months, to the exclusion of the stars, has begun to intermit its brightness. Even Aldebaran, the red eye of the bull, flared out into familiar recollection as early as ten o'clock; and the heavens, though still somewhat reddened by the gaudy tints of midnight, gave us Capella and Arcturus, and then that lesser light of home memories, the Polar Star. Stretching my neck to look uncomfortably at the indication of our extreme northernness, it was hard to realise that he was not directly overhead; and it made me sigh as I measured the few degrees of distance that separated our zenith from the Pole over which he hung.

October 28.—The moon has reached her greatest northern declination of about 25° 35′. She is a glorious object; sweeping around the heavens, at the lowest part of her curve, she is still 14° above the horizon. For eight days she has been making her circuit with nearly unvarying brightness. It is one of those sparkling nights that bring back the memory of sleigh-bells and so gs, and glad communings of hearts in lands that are far away.

November 7.—The darkness is coming on with insidious steadiness, and its advances can only be perceived by comparing one day with its fellow of some time back. We still read the thermometer at noonday without a light, and the black masses of the hills are plain for about five hours, with their glaring patches of snow; but all the rest is darkness. The stars of the sixth magnitude shine out at noonday. Except upon the island of Spitzbergen, which has the advantage of an insular climate, and tempered by ocean currents, no Christians have wintered in so high a latitude as this. They are Russian sailors who made the encounter there—men inured to hardships and cold. Our darkness has ninety days to run before we shall get back again even to the contested twilight of to-day. Altogether our winter will have been sunless for 140 days.

November 9.—Wishing to get the altitude of the cliffs on the south-west cape of our bay before the darkness set in thoroughly, I started in time with my Newfoundlanders at noonday, the thermometer indicating 23° below zero. Fireside astronomers can hardly realise the difficulties in the way of observations at such low temperatures. The breath, and even the warmth of the face and body, cloud the sextant-arc and glasses with a fine

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hoar frost. It is, moreover, an unusual feat to measure a base line in the snow at 55° below freezing.

December 15.—We have lost the last vestige of our mid-day twilight. We cannot see print, and hardly paper; the fingers cannot be counted a foot from the eyes. Noonday and midnight are alike, and except a vague glimmer in the sky, that seems to define the hill outlines to the south, we have nothing to tell us that this Arctic world of ours has a sun. In the darkness, and consequent inaction, it is almost in vain that we seek to create topics of thought, and, by a forced excitement, to ward off the encroachments of disease.

January 21.—First traces of returning light, the southern horizon having for a short time a distinct orange tinge.

February 21.—We have had the sun for some days, silvering the ice between the headlands of the bay; and to-day, towards noon, I started out to be the first of my party to welcome him back. It was the longest walk and toughest climb that I have had since our imprisonment, and scurvy and general debility have made me "short o' wind." But I managed to attain my object. I saw him once more, and upon a projecting crag nestled in the sunshine. It was like bathing in perfumed water.

Thus this terrible winter night drew to its end, and the time came for undertaking the sleigh journeys, on which the success of the expedition mainly depended. Unfortunately, of the nine magnificent Newfoundlanders and the thirty-five Esquimaux dogs originally possessed by Kane, only six had survived an epizootic malady which raged among them during the winter; their number was, however, increased by some new purchases from the Esquimaux who visited the ship at the beginning of April.—Hartwig's *Polar World.*

Solar Eclipse.—It is stated in Guillemin's "Heavens" that the totality of the Eclipse of August 1887 will cross the N.E. of Germany. Can any of your readers inform me whether it will cross any part of Britain, and how soon after sunrise the totality will be attained in Germany?

Astronomicus.

Occultation of Saturn.—An occultation of this planet by the Moon will take place on Friday evening, the 30th of September. The immersion will commence at four minutes past 6 o'clock; the planet will reappear at eighteen minutes past 7. The meridian passage of the Moon will take place at eleven minutes before 5 o'clock; the meridian passage of Saturn at eight minutes before 5. The Moon will be very near to her first quarter, and the phenomenon will occur about one hour and a quarter (in R.A.) to the west of the meridian. Declination of Saturn, 22° 15′ south.

Heat, and the Earth.—If we know the velocity and weight of any projectile, we can calculate with ease the amount of heat developed by the destruction of its moving force. For example, knowing as we do the weight of the earth and the velocity with which it moves through space, a simple calculation enables us to state the exact amount of heat which would be developed, supposing the earth to strike against a target strong enough to stop its motion. We could tell, for example, the number of degrees which this amount of heat would impart to a globe of water equal to the earth in size. Meyer and Helmholtz have made this calculation, and found that the quantity of heat which would be generated by this colossal shock would be quite sufficient, not only to fuse the entire earth, but to reduce it, in great part, to vapour. Thus, by the simple stoppage of the earth in its orbit, "the elements" might be caused "to

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melt with fervent heat." The amount of heat thus developed would be equal to that derived from the combustion of fourteen globes of coal, each equal to the earth in magnitude. And if, after the stoppage of its motion, the earth should fall into the sun, as it assuredly would, the amount of heat generated by the blow would be equal to that developed by the combustion of 5,600 worlds of solid carbon. — *Tyndall's Heat a Mode of Motion.*

D'ARREST'S COMET.

The following Ephemeris of this body for the month of September has been forwarded to us by Mr. Chambers:--

Berlin Mean Moon.

1870.	R.A. h.	m.	s.	N.P.D. °	′
September 1	16	39	52	100	57
3	16	45	19	101	52
5	16	50	58	102	46
7	16	56	48	103	40
9	17	2	51	104	34
11	17	9	4	105	27
13	17	15	30	106	19
15	17	22	6	107	10
17	17	28	54	108	0
19	17	35	53	108	49
21	17	43	2	109	37
23	17	50	22	110	23
25	17	57	53	111	8
27	18	5	33	111	50
29	18	13	22	112	31

The comet attains its greatest brilliancy about September 8.

ASTRONOMICAL REGISTER—Subscriptions received by the Editor.

To September 1870.
Denning, W. F.
Wright, W. H.

To October 1870.
Lewis, H. K.
Reside, J.

To November 1870.
Blacklock, A.

To December 1870.
Fleming, Rev. D.
Rump, H. R.

To June 1871.
Green, Jos.
Welch, J. P.

To December 1871.
Ratcliffe, J.

August 22, 1870. Subscriptions after this date in our next.

NOTICES TO CORRESPONDENTS.

ASTRO-METEOROLOGY.—We have received several communications from Mr. Pratt and one also from *Empirici Osor*, but as the subject is not an astronomical one we do not wish to continue the controversy.

Several communications, which did not reach us until after the 17th of the month, are deferred until next number.

THE ECLIPSE OF THE SUN, IN DECEMBER NEXT.—We are informed that the Government have refused the use of a steamer or any other assistance to the Eclipse Expedition.

N.B.—For Sale, a set of the Large Maps of the S.D.U.K., coloured, in good condition.

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ASTRONOMICAL OCCURRENCES FOR SEPT. 1870.

DATE		Principal Occurrences		Jupiter's Satellites		Meridian Passage
		h. m.			h. m. s.	h. m. Moon
Thur	1	3 0	Sidereal Time at Mean Noon, 10 41 47·3 Conjunction of Mars and μ^2 Cancri, 9m·6 E.	1st Ec. D. 2nd Sh. I. 1st Oc. R. 2nd Sh. E. „ Tr. I.	12 18 22 13 48 15 49 16 20 16 28	5 2·2
Fri	2	1 58 22 43	☽ Moon's First Quarter Conjunction of Moon and Saturn, 1° 10′ S.	1st Tr. I. „ Sh. E. „ Tr. E.	10 51 11 46 13 5	5 57·8
Sat	3			2nd Ec. R. „ Oc. D. „ Oc. R.	11 4 19 11 15 13 51	6 54·6
Sun	4	8 7 9 25	Occultation of B.A.C. 6448 (6) Reappearance of ditto			7 51·6
Mon	5		Saturn's Ring: Major Axis = 38″·2 Minor Axis = 17″·4	3rd Tr. I. „ Tr. E.	12 46 15 12	8 47·8
Tues	6					9 42·0
Wed	7	16 33	Greatest Easterly elongation of Mercury 26° 48′	1st Sh. I.	16 57	10 33·3
Thur	8			1st Ec. D. 2nd Sh. I.	14 11 45 16 22	11 21·7
Fri	9			1st Sh. I. „ Tr. I. „ Sh. E. „ Tr. E.	11 26 12 46 13 40 15 1	12 7·5
Sat	10	10 12	○ Full Moon	2nd Ec. D. 1st Oc. R. 2nd Ec. R. „ Oc. D. „ Oc. R.	11 12 23 12 13 13 41 27 13 54 16 30	Venus A.M. 10 33·7
Sun	11		Declination of Venus: + 31° 41½′			10 34·6
Mon	12			2nd Tr. E. 3rd Sh. I. „ Sh. E. „ Tr. I.	10 58 11 25 13 48 16 50	10 35·4
Tues	13	9 27 9 33 16 48	Occultation of ξ^2 Ceti (4) Reappearance of ditto Conjunction of Venus and Regulus, 7m·3 W.			10 36·2
Wed	14					10 37·1
Thur	15		Illuminated portion of disk of Venus = 0·932 of Mars = 0·941	1st Ec. D.	16 5 8	10 37·9

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DATE		Principal Occurrences		Jupiter's Satellites		Meridian Passage
		h. m.			h. m. s.	h. m.
			Sidereal Time at Mean Noon, 11 40 55·6			Venus —
Fri	16	4 54	Conjunction of Mercury and Spica Virginis, 15m·8 E.	1st Sh. I. „ Tr. I. „ Sh. E. „ Tr. E.	13 20 14 40 15 34 16 55	A.M. 10 38·7
		10 11 11 7	Occultation of *i* Tauri (5½) Reappearance of ditto			
Sat	17	13 30 14 9	☾ Moon's Last Quarter Conjunction of Moon and Jupiter, 1° 17′ N.	1st Ec. D. 2nd Ec. D. 1st Oc. R. 2nd Ec. R. „ Oc. D.	10 33 28 13 49 3 14 6 16 18 29 16 32	10 39·4
Sun	18			1st Sh. E. „ Tr. E.	10 2 11 24	10 40·2
Mon	19			2nd Sh. E. „ Tr. I. „ Tr. E. „ Sh. I.	10 46 10 56 13 33 15 25	10 41·0
Tues	20	0 53 22 36	Conjunction of Moon and Uranus, 0° 20′ S. Conjunction of Moon and Mars, 0° 44′ S.			10 41·7
Wed	21					10 42·5
Thur	22					10 43·2
Fri	23	7 13	Conjunction of Moon and Venus, 2° 59′ S.	3rd Oc. D. „ Oc. R. 1st Sh. I. „ Tr. I. „ Sh. E.	10 42 13 10 15 14 16 34 17 28	10 43·9
Sat	24	18 34	● New Moon	1st Ec. D. „ Oc. R. 2nd Ec. D.	12 26 52 15 59 16 25 38	10 44·6
Sun	25	15 11	Conjunction of Moon and Mercury, 9° 29′ S.	1st Sh. I. „ Tr. I. „ Sh. E. „ Tr. E.	9 42 11 2 11 36 13 17	10 45·3
Mon	26			1st Oc. R. 2nd Sh. I. „ Sh. E. „ Tr. I. „ Tr. E.	10 27 10 46 13 20 13 28 16 4	10 46·0
Tues	27		Declination of Venus: + 6° 46½′			10 46·7
Wed	28			2nd Oc. R.	11 0	10 47·4
Thur	29					10 48·1
Fri	30	6 12 6 4 7 18	Conjunction of Moon and Saturn, 0° 56′ S. Occultation of Saturn Reappearance of ditto	3rd Ec. D. „ Ec. R. „ Oc. D. „ Oc. R. 1st Sh. I.	9 23 20 11 36 31 14 35 17 3 17 8	10 48·7
Sat Oct	1	9 19	☾ Moon's First Quarter	1st Ec. D. „ Oc. R.	14 20 16 17 51	10 49·4

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THE PLANETS FOR SEPTEMBER.

At Transit over the Meridian of Greenwich.

Planets	Date	Right Ascension	Declination	Diameter	Meridian Passage
		h. m. s.	° ′		h. m.
Mercury	1st	12 15 16	−3 19	6″·2	1 33·2
	15th	13 0 35	10 9½	7″·9	1 23·3
Venus	1st	9 11 46	+16 54½	11″·0	22 26·3
	15th	10 19 22	11 40½	10″·6	22 38·7
Jupiter	1st	5 32 18	+22 44	35″·4	18 47·5
	15th	5 38 52	22 48	37″·0	17 58·9
Saturn	1st	17 25 12	−22 7½	15″·4	6 42·3
	15th	17 26 28	22 11½	15″·0	5 48·5
Neptune	2nd	1 21 51	+6 46½	—	
	18th	1 20 33	6 38	—	

Mercury arrives at its greatest easterly elongation on the 7th of September, and is therefore favourably situated for observation in the evenings at the beginning of the month, setting about an hour and a half after the Sun. It afterwards approaches the Sun until it arrives nearly at inferior conjunction at the end of September.

Venus may still be seen before sunrise, passing the meridian about half-past 10 at the beginning of September, and about a quarter before 11 at the end of the month. The diameter of the planet is now about 10 seconds only. On the 13th Venus will be in conjunction with the bright star Regulus—a pair of fine objects for daylight observation with telescopes of moderate power, though perhaps too near the Sun.

Jupiter passes the meridian about a quarter before 7 in the morning at the beginning of September, and about 5 o'clock at the end of the month. The planet may consequently be well observed from shortly after midnight until daybreak.

Saturn continues conspicuous in the west, passing the meridian about a quarter before 7 at the commencement of the month, and shortly before 5 o'clock at the end of September.

Neptune may now be observed with advantage, passing the meridian about half-past 2 in the morning at the beginning of the month, and about twenty minutes before 1 at the end of September.

The Astronomical Register is intended to appear at the commencement of each month; the Subscription (including Postage) is fixed at **Three Shillings** per Quarter, *payable in advance*, by postage stamps or otherwise.

The pages of the *Astronomical Register* are open to all suitable communications. Letters, Articles for insertion, &c., must be sent to the Editor, Mr. S. Gorton, *Parnham House, Pembury Road, Clapton, N.E.*, **not later than the 15th of the month.**

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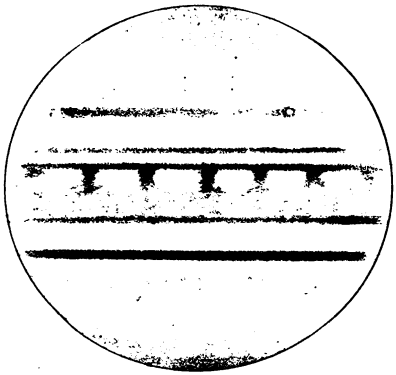
1



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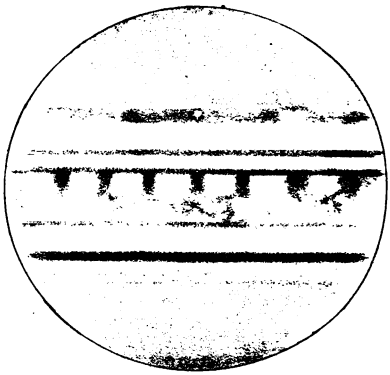
2



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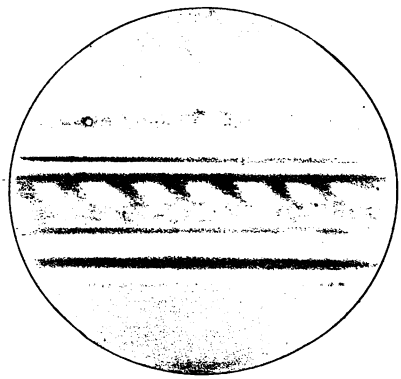
3



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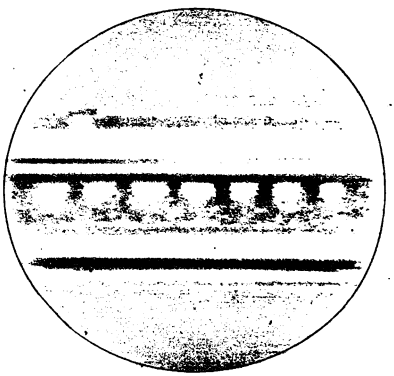
4



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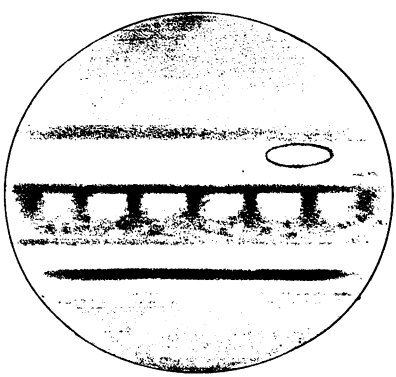
5



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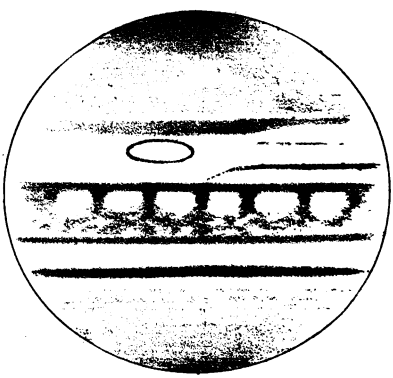
6



1870 Jan.y 23
at 8h 20m G.M.T.

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The Astronomical Register.

No. 94. OCTOBER. 1870.

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OBSERVATIONS OF JUPITER.

By Joseph Gledhill, F.G.S., F.M.S.

Made at the Observatory of Edward Crossley, Esq., F.R.A.S., Park Road, Halifax.

Telescope, 9⅛ inches aperture: focal length, 12 ft. 4½ in.

During the last apparition of this noble planet, the disc was regularly and carefully scrutinised at this observatory from November 1869 to February 26, 1870, and some fifty drawings were made. Full descriptions of the various interesting and curious features were also entered in the note-books. A feeling, however, that most probably many experienced observers would shortly publish their observations, accompanied by good and well-chosen sketches, induced us to wait until April of this year before we sent any account to the journals of what had been done at this place.

In the *Register* for April a general account of the more striking phenomena was given, and further observations promised. Months passed, and still no systematic observations and plates appeared in the scientific journals. In June, however, a letter from Dr.

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Mayer of the Lehigh University, Pennsylvania, accompanied by his interesting paper and lithograph of Jupiter, induced us to take our drawings to the lithographer. After much delay and difficulty the lithographs at the head of this paper were obtained; and although, as regards finish and softness, they are not all we could have wished, yet in other respects they faithfully convey the impressions received at the telescope.

They are intended to exhibit all the most prominent and some of the difficult details seen on the disc during one rotation of the planet. When these drawings were completed, the desire naturally arose of comparing them with those executed by distinguished astronomers in past times; and on looking over the books on our own shelves, we were struck by the extreme paucity of good delineations of this magnificent planet. And this was the more difficult to understand when we considered the noble disc it presents, the gigantic nature of the physical forces in operation, the comparatively small optical power required, and the great number of instruments of large aperture in the hands of amateur astronomers of the present day.

Few indeed were the sets of plates which gave a view of the opposite hemispheres. And although the physical forces at work on this huge sphere are of such a character as to cause the distribution of clouds to be pretty uniform in the same latitude, yet it cannot be doubted that many most interesting features have been lost by neglecting to secure complete representations of the sphere. Of the plates of Jupiter we found, the following is a list which may possess some interest:—

1645. *Hevelius* (Selenographia) gives a figure in the Prolegomenæ. No parallel bands are shown: continuous cloudy patches, roughly parallel, run from north to south.

1713. *Francisco Blanchini* (Observationes Selectæ) gives two figures, but it is very probable they were not meant to represent the whole of the markings seen on the disc. One shows two broad, dark bands, one on each side of, and parallel to, the equator; the others give only one broad, dark band, and it is to the south of the equator.

1785. *Schröter* (Beiträge zu den neusten astronomischen Entdeckungen) gives us ten woodcuts. They all have a broad band on each side of the equator and near it: some give a band near the north, and others are near the south pole. In one there is a narrow streak connecting the two central bands, and reminding one of that seen in Baxendell's beautiful drawing. These figures show many small dark spots, and to these Schrœter gave his special attention in his attempt to discover the rotation period of the planet.

1834. *Mädler* (Beiträge zur physischen Kenntniss, &c.) gives five plates. Three of them show a broad, dark band near to the equator, one on each side, and traces of a streak to the N. and S. of these. Large spots are also seen on the northern equatorial bands. In all the above representations the region near the equator is bright.

The drawings of Sir John Herschel are too well known to need description here.

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1850. *Lassell* (Astronomical Notices, Vol. X.) gives a woodcut showing two very broad, dark bands in the southern hemisphere (the more northern having its north edge on the equator), and several narrow streaks in the northern. Six small bright spots are seen on the most southern belt.

1856. *De la Rue* (Chambers' Astronomy.) This is a magnificent picture: two enormous dark zones, full of character, stand one north and one south of the equator. In this year Professor Smyth executed three splendid drawings of Jupiter (*Philosophical Transactions*, 1858). They exhibit four principal belts corresponding pretty closely to Nos. 2, 3, 4, and 6. The most northern is very narrow in two of the figures, but broad in the third. The equatorial region is bright.

1857. *Dawes* (Astronomical Notices, Vol. XVIII.) made many drawings in this year, and in exquisite beauty of detail, richness of form and shade, the disc at this time has not been surpassed. He gives many bright spots in the southern broad band.

1858. Lassell saw bright spots in the central bright zone. The belts had altered much since Dawes sketched the disc. The streaks are numerous, but narrow.

In 1860 and 1863 exquisite sketches were made by Jacob, Baxendell, and Gorton, and are given by Chambers in his valuable treatise on Astronomy. These, compared with the drawings in 1869 and 1870, indicate changes of the most stupendous nature. It deserves special remark that in 1869 and 1870 the equatorial region was dark.

The following are the detailed observations:—

1869.

Oct. 21st, 12h.—Band No. 4 was observed to be broken near the W. extremity. The E. half was dark and sharp, while the W. half was faint.

Oct. 26th, 9h.—A short dark streak connected bands 4 and 5: it was near middle of that part of the disc. It is extremely probable that this object was the E. end of the ellipse.

Nov. 4th, 13h.—Upon the upper and lower edges (but still within the band) of 6, are now seen several small, bright, circular spots. Some 8 or 10 were counted, but the motion was too great to allow of fixing their exact position.

Band 2 was broken near its W. extremity.

Nov. 6th, 11h. 45m.—The break or gap in band 6 was seen to have a loop or bridge thrown across the opening towards the N.

Nov. 9th, 7h.—Band 2 was apparently rough and irregular in outline. At 11h. a large bright spot, the diameter of which was one-third that of the band, lay in the middle of 6, and in the centre of that portion of the disc.

Nov. 10th, 13h.—The narrow northern band, No. 1, was now seen to be much darker in the middle than near its extremities.

Nov. 14th, 10h. 50m.—Several small, bright, circular spots were seen on 6. At this time No. 4 seemed considerably bent towards the N. at its E. extremity. It was very dark at this place.

No. 5 has come on the disc and slopes down to 4, but the space between the two bands is dusky, and not, as is usually the case, bright.

No. 1 was now seen to be broken in the middle, where it was also darkest.

Nov. 15th, 12h.—Bright spots were seen on 6; motion on disc very great. At 13h. 15m. a faint circular spot was seen in middle of 6.

Nov. 16th, 12h.—A thin dark streak seemed to lie from the NE. corner of the ellipse to band 5.

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Several small bright spots were seen on 6; one lay just over the W. end of the ellipse: another was midway between this and the W. edge of disc.

Again the space between 4 and 5 was dusky.

Nov. 19th, 6h. 30m.—Under 4 was seen a large dark square space; a smaller one lay a little to the W. At 7h. a minute spot was seen just in advance of the gap in 6.

At 7h. 45m. the gap in 6 was again seen with a connecting bridge on the N.

Flecks of light were at this time seen in the dusky southern polar region, especially near 6.

At 9h. 45m. several spots were seen on 6.

At 11h. 30m. band 4 was again seen bent to N. at the E. end.

Nov. 25th, 9h.—Three small bright spots were seen to the E. of the gap in 6, and within the band; others were suspected on the W. of the gap.

At 10h. 30m. a small bright circular spot was seen just to W. of the ellipse on 6. The break or gap in 2 was now again seen. The whole band was apparently broken up into many nearly detached portions. No. 6 was irregular at its upper edge as if indented by light flecks.

At 11h. 15m. two large ellipses lay in the centre under 4, and looked like great staring eyes; one also lay under the eastern ellipse, having its north edge resting upon band 3.

Nov. 28th, 8h. 30m.—Band 1 was dark along the eastern half.

At 10h. 45m. a large bright spot was seen in the middle of 6.

At 11h. 5m. a bright spot lay on lower edge of 6 but within it, and near W. end of ellipse; a second was seen upon the upper edge of 6, a little to the W.; and a third still more to the W. but on the lower edge.

Nov. 30th, 9h.—The spots to the W. of the ellipse were again seen on 6.

At 11h. the western portion of No. 1 was dark.

The bridge under the gap in 6 was again seen.

At 12h. 15m. a large spot was seen in the middle of 6, another half way towards the E. edge of disc, and a third a little to the E. of the first, but upon the band. In diameter the central spot exceeds the others, and its diameter is fully one-third that of the band.

Dec. 4th, 7h. 15m.—The spots were seen to the W. of the ellipse.

At 7h. 30m. two dark swellings were seen on No. 1, near the W. extremity. The western half of this band was dark, well seen, and stood well off from the dusky shading of the N. polar region.

Dec. 10th, 9h.—The dark elliptic forms under 4 were not now seen, but dark flocculent lines inclined to E. across the dark zone; this was often seen, but only on bad nights.

Dec. 13th, 9h.—A large bright space was seen about the W. end of the ellipse in band 6. A smaller round spot was also seen in 6, above the middle of the ellipse.

At 10h. 30m. band 4 was seen, bent slightly upwards, as if the ellipse which lies under it had been pushed southwards.

Dec. 21st, 11h. 10m.—Under 4 in centre of disc was a large flat ellipse above its western end, and on 5 was seen a dark protuberance. The whole of band 5 was much broken up.

Dec. 27th, 6h.—The dusky patch close to W. of gap in 6, and upon that band, was well seen now.

At 9h. 10m. a fine large spot was seen in the middle of 6; another was seen midway between it and E. edge of disc.

1870.

Jan. 25th—(Tuesday). The sky cleared at 5h. and the night was superb.

Power 240 was used with the full aperture. There was no motion on the disc.

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At 5h. 35m. a very fine, large, bright circular spot was seen within No. 6, near its upper edge, a little to W. of its middle point. The diameter of this spot appeared fully one-third that of the band. Not far from the E. edge of the disc was seen what appeared to be a large, bright spot with a dark square patch above it. After watching this object to the middle of its path, I could not be sure that the spot was round. Sometimes I thought the band was quite cut through on the N., and at first took the whole object for the well-known "break" in No. 6. It was never easy and good to see. On reflection and comparison of times of transit, it occurred to me that I had been thus baffled on a previous occasion; and a reference to the notes made in 1869 gives 11h. 30m., Nov. 30, as the time when a loop was seen lying under No. 6, and being rather a difficult object, was taken for the "break" by a friend who was examining the planet. But the "break" had passed the centre at about 7h. 40m. So also on the present occasion I had but to wait for about an hour to decide the question; and at 7h. 15m. the expected loop appeared again. Just to the E. of it, and within No. 6, was a fine, large, bright spot. A second spot was also seen nearer the E. edge of the disc, also in No. 6.

At 8h. 10m. the two light streaks seen on the 23rd appeared again on No. 6. After long and patient scrutiny while these faint objects were far from the edge of the disc, I could regard them only as two small oval bright spaces, very much like those under No. 4. They lay in the bright zone between No. 6 and the dusky shade of the southern pole.

At 9h. 50m. the southern ellipse was on the disc; No. 5 was again seen to pass on to the NE. corner of the ellipse and not to slope down to No. 4.

JOSEPH GLEDHILL, F.G.S. &c.

THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.—MEETING AT LIVERPOOL, 1870.

MATHEMATICAL AND PHYSICAL SCIENCE.—The proceedings of this section opened on September 16th, under the presidency of Mr. J. Clerke Maxwell, F.R.S. Professor Huxley, president of the British Association, was present.

Mr. James Glaisher, F.R.S., superintendent of the Meteorological Department of the Royal Observatory at Greenwich, read the annual report, "On Luminous Meteors." The first part of the report spoke of the loss experienced by the Committee in the death of Professor E. Brayley, a philosopher who had given the Committee much information on the astronomy of aerolites, from observations extending over many years. From investigations on the microscopic structure of meteorites and other data, he had also written a valuable paper on the origin of these bodies. He likewise had given much attention to the theory that the paths of shooting stars are connected with the orbits of comets, and in an address which he drew up about the sun, he pointed out that a part of the light of the corona surrounding the sun might be due to the reflection of the solar light from meteoric bodies near the atmosphere of the sun. The Committee recommended that Mr. C. Brooke, F.R.S., should be appointed as his

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successor. Mr. Glaisher then spoke of a great fireball, seen in the south of Europe, in course of the month of September 1869, which fireball was well seen and its course noted by no less than sixty-three observers. It was seen near the Lake of Geneva at ten minutes to seven, immediately after sunset. It looked like a red-hot ball with a fiery tail, and accompanying sparks. It lasted about five seconds, and was in very close proximity to the earth. Its course was traced across a large portion of Europe, and it was last seen in the south of France. Several other meteors were seen here and there at about the same time. He then spoke of the last great meteoric shower of November 1869; the sky in England was at the time for the most part overcast, although at some few points of observation it was clear; in the course of the evening a fireball was seen, and its calculated height obtained. The speaker next called attention to the star-showers observed in other countries, and said that the estimated mean height of the August meteors is seventy-three miles at the point of their appearance, and forty-five miles from the surface of the earth at the point of their disappearance. It is very difficult to gain information as to the height of the November meteors, because they are so very numerous that it is very rarely that observers at different places are quite sure that their separate observations refer to the same meteor.

Mr. W. R. Birt, in a short paper on the changes taking place on the surface of the moon, speaking of the observations of the crater Linné, respecting the alleged changes in which there has been so much discussion among astronomers, said most observers are agreed that if some of the early pictures of the top of this lunar mountain are accurate, a change must have taken place. No change has been noticed in the crater within the last few years.

A paper on "The Grouping of the Stars," by Mr. Richard A. Proctor, B.A., F.R.A.S., was then read by the Secretary, and it set forth that hitherto Sir William Herschel and other astronomers have considered the sidereal system to consist of uncounted millions of suns, spread broadcast over the heavens without any approach to uniformity, and not aggregated into any such streams, groups, or clusters, as could be recognised by the study of the lucid stars alone. The paper then went on to show that laws of aggregation and segregation exist among the stars to such an extent as to render the results of ordinary star-guaging questionable. It further gave statistical facts respecting the lucid stars, showing that the probabilities against the idea of stars being distributed in a chance manner were perfectly overwhelming. The general tendency of the paper was to show that the stars are grouped together in varied forms, separated by comparatively barren distances from each other.

The president called attention to a somewhat comical experiment made by the Astronomer-Royal for Scotland, who splashed some whitewash from a brush over a black board, in order by the grouping of the spots to try to discover some of the principles governing the grouping of the stars.

THE PARIS OBSERVATORY.—We understand that the valuable instruments &c. of this establishment are being placed in the cellars of the building, so as to protect them as far as possible from damage in the case of the siege being carried to extremities.

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THE GREAT MELBOURNE TELESCOPE.

The interest attaching to this important instrument is so great that we do not hesitate to present our readers with the following somewhat long extract of the 16th July last, on the subject, from *The Illustrated Australian News*, commencing with

A Discussion at the Royal Society (Victoria).

An ordinary meeting of the Royal Society took place on the 13th June, Mr. Ellery in the chair. There was a full attendance of members and visitors, the latter including several ladies.

Mr. Severn read his paper on the Great Melbourne telescope. He commenced by explaining the various forms given to the reflecting telescope, pointing out the differences between Newton's, Gregory's, Herschel's, and Cassegrain's. In the Gregorian and Cassegrain, the main tube is closed by the large speculum, which has a hole through its centre, the eye-piece being outside the back of the large metal. The rays of light entering the tube fall upon the reflecting surface of the large speculum, and thence converge towards and on to a small speculum (concave in the Gregorian, and convex in the Cassegrain), which again reflects them to the eye-piece. In the Newtonian the large speculum is solid, the light converging on a plane mirror at an angle of 45 degrees, which reflects it at right angles to the primary ray, into the eye-piece at the side. The Herschelian uses the whole of the reflecting surface of the speculum, and is the simplest in construction. The speculum is slightly tilted, or its plane is not at right angles to the tube, the focus being thrown to the side of the tube's mouth, where it is viewed with the eye-piece. The achromatic or refracting telescope is composed of two or three lenses, which refract the incident rays to one focus, producing a colourless image. In comparing these it becomes necessary to understand the true meaning of the terms aperture, light, definition, and power. Unless the speculum is a perfect parabola the whole surface will not reflect the light into a perfect focus. Aberration will be produced. The aberration from distortion arises from a variety of causes, all more or less foreign to the first true figure given to the speculum. Thus the metal of which it is composed cannot be chemically homogeneous in all its points. It becomes unequally affected by variations of temperature, causing it to expand and contract, and producing a change in the otherwise tranquil position of the molecules of the mass. The movement of the telescope may also disturb the speculum, if not at perfect rest on its bed of levers. The result of these movements will be the production of numerous images in the place of one. Definition can only exist when aberration is absent. There is a distinction between magnifying power and light power, or the power of seeing very faint objects. The want of definition, or the presence of aberration, very much affects the character of the image which should be seen. It causes a want of distinctness and also a loss of light or seeing power. This is actually equivalent to a reduction of aperture. We may be looking through a telescope having a 4-foot aperture, and yet not be receiving the light of a 4-foot speculum. Such an instrument would necessarily be of little use. Light power, or the power of seeing very faint objects, depends, undoubtedly, very much on a large, ample aperture; but, for instance, a 4-foot, with plenty of aberration, may not have as much light power as a 2-foot with less aberration, or a 12-inch aperture with a perfect focus. After detailing these and some other leading features of the

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reflecting and refracting telescope, Mr. Severn proceeded to examine into the details and to criticise the theories that caused a reflecting telescope to be selected in place of an achromatic, and to adduce his reasons for stating that the great Melbourne telescope would be, is, and must prove, a lamentable failure. The committee of the Royal Society, to whom the matter was referred, recommended a 4-foot reflector; and, in stating their reasons for doing so, referred to the elder Struve, who "seems to think that the Dorpat achromatic of 9·58 inches diameter may rank with the most celebrated of all reflectors, namely, Herschel's." Upon this they say that "he cannot mean the most celebrated one—that known as the 40-foot; but, if we even suppose him to speak of the 18-inch front view, the statement is preposterous." Mr. Severn maintains, on the contrary, that the great Struve made a most judicious comparison. The aberration of the 40-foot was tremendous—infinitely greater than in Sir John's 18-inch. The Dorpat refractor may have far excelled the 40-foot, and yet perhaps have only equalled the much more perfect 18-inch. The light power of the 40-foot was never equal to its aperture, while the 18-inch was a much nearer approach to full light, because aberration was nearly absent in the latter. Sir John Herschel, referring to the nebula in Orion, says that "when examined under the great light of Lord Rosse's reflector, or the exquisite defining power of the great achromatic at Cambridge, U.S., it is evidently proved to consist of stars." Such is his opinion of the performance of a 14-inch achromatic compared with and doing the same class of work as the 6-foot reflector. Mr. Proctor bears similar testimony as to the nebula in Andromeda. Theoretically a 6-foot, or even 4-foot, aperture reflector has no opponent, if it is perfect. The summing up of Mr. Robinson and Mr. Grubb is that a refractor, to be equal to the great Melbourne telescope, would require an object-glass of some 35 inches diameter. Such a statement is preposterous. Why, if a 35-inch achromatic were only equal to the great Melbourne telescope, it would require one of 52 inches aperture to equal the Rosse reflector; whereas, in practical work, a 14-inch achromatic is doing the same work as the Rosse 6-foot, simply because the latter has a tremendous aberration, and is only equal to two feet of real light aperture. Sir William Herschel's 40-foot "crushed a star into a cocked hat." A distinguished foreign astronomer was once invited to look at Saturn through Rosse's 6-foot, and his report of what he saw was thus worded:—"They showed me something, and told me it was Saturn, and I believed them." Mr. Proctor, referring to this, says that great reflectors are not constructed for that sort of work. Their object is to bring into view those outlying regions of space which are hidden in the twilight of vast distance. This is the only cry in favour of the great Melbourne telescope, but it cannot be allowed for a moment that a reflector which won't show Saturn enables us to view a nebula with the light of a 6-foot aperture. The truth is, that the Rosse 6-foot being the largest, has of course the best chance, notwithstanding its aberration, to bring to focus the most light, or to enable it to rank with the perfect 14-inch achromatic. The statement of Messrs. Robinson and Grubb that large specula can be finished to possess the defining powers in a high degree, is totally at variance with facts. Sir William Herschel's was dismantled, on account of want of definition. Lassell's showed phenomena which never took place. The great weight of evidence that caused the Royal Society committee to select a 4-foot reflector in place of a 15-inch achromatic, is totally against a large reflector. The Royal Society committee may be accused of a great want of fairness, and they appear to have allowed themselves to be led away by theories without foundation.

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The largest Cassegrain appears to have been of 18 inches diameter. Dr. Robinson admits that the step from 18 to 48 inches was an adventurous one. Its greatest defect is the difficulty of obtaining a low magnifying power, the small speculum magnifying the image from the great one from five to six times. This defect is claimed by Dr. Robinson as an advantage, as affording facilities for micrometer measurement. It is to suit him and Mr. Grubb that it is both a great advantage and a great disadvantage. It is further claimed that "the errors of the small speculum tend to correct those of the larger." This cannot be admitted; for whatever correction the rays may receive, it is all lost by the enlargement of the image. Thus the errors of the large metal are greatly magnified. But the greatest of all advantages, they say, is the facility which it offers to the observer. This is really the greatest praise that can be given it, and it should be admitted, were it not for the very grave question—Is it better for the observer to be reclining comfortably on his back, exquisitely padded here and there with cushions, and examining badly defined objects, objects hardly legible, and objects of unknown forms, than to be thirty feet high with a Newtonian, uncomfortable, with no sofa to recline on, but looking at objects well defined, well lighted, and of well-known forms? Sir William Herschel, Rosse, Sir John Herschel, Lassell and others, one and all preferred the latter. Are we, in these days of grand physical inquiry, to be crippled and outstripped because ease and comfort are considered of greater value than keen observation? It is pretty apparent that Victoria has to test an experiment which no government, no nation, and no individual had dared to venture upon during a whole century; that it is left for this colony to ignore all the experience and all the tremendous labour incurred by Newton, Herschel, Rosse, Lassell, and others, upon which hundreds of thousands of pounds have been expended, and try for the first time what they but repudiated—a gigantic experiment at the imminent risk of failure. The construction of such a large reflector as the great Melbourne telescope is an immensely difficult task. The beds of turned hoop-iron on which the speculum is cast are almost certain to wind or to twist, because while there is great resistance to flexure in the direction of the hoop-iron, there is none whatever crosswise. Mr Severn described a plan of his own, which has several important qualities. An iron ring is placed upon the pattern of the speculum, and in place of hoop iron the central space is filled up with short pieces of quarter-inch iron wire standing endwise. When the whole space has been filled up it is only necessary to drive smaller pieces of wire in between the interstices. When all is firm the iron ring is heated by placing a larger red-hot ring outside of it. This causes it to expand, and more short pieces of fine wire are driven in. As the wire cools it strikes equally around the centre, thus rendering the whole a very hard, compact, rigid mass, of great strength, the resistance to flexure being equal in every direction. The first cast for the Melbourne speculum had a large cavity, about nine inches long, inside the centre of the speculum. If it had been polished it might have changed with variation of temperature. This is not a comfortable idea, inasmuch as there can be no proof of the absence or existence of a cavity unless the metal is smashed. Another difficulty is the omission of the mean temperature of the air when the specula were figured, polished, and finished. The molecules of the mass can be at rest at this one temperature only. In March 1868 Mr. Severn drew special attention to this difficulty. He pointed out that the completion of a 4-foot metal in a northern cold climate with a view to its ultimate use in Melbourne, was a very precarious experiment, and that the truly parabolic speculum which Mr. Robinson speaks of as having defined

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α Lyræ may, in our mean temperature, be so materially altered as not to define Rigel. It may even be found necessary to stop off the usual portion of the metal on account of elongation of focus, or to refigure and polish. The one would spoil the instrument for light, the other might endanger its existence. The work the telescope has done will confirm these opinions. In October 1867 Dr. Robinson examined and reported on the telescope, but out of eighteen nights there was only one of even middling goodness, but this was sufficient to satisfy him that there was less difference from Rosse's 6-foot than he expected. "A few pretty close double stars were well and clearly separated." To compare this with the present state of the instrument, Mr. Le Sueur invited Mr. Severn to look through the telescope. The night was exceedingly fine—Venus, though too low, the Moon, Jupiter, and Orion all in fine positions for observation. He was prepared to see failure, but was not prepared to see failure so predominant. To give the instrument every chance, the lowest powers were used; but with them even the light was not by any means startling, and the definition was as bad as it could possibly be. It was bad from both spherical aberration and aberration due to distortion. Every object examined was equally bad. The telescope was totally unable to "clearly separate pretty close double stars." This it never has done and never can do in this country. And this only applies to low powers. What kind of figure would a double star, say *alpha* Crucis, cut under the 500 or 600 power? Why, it might with propriety be taken for a burning hayrick. Mr. Le Sueur distinctly admits that light and definition have not coincided in the Melbourne reflector. Hence it must be inferred that the instrument suffers from aberration, more or less. The aberration is probably very great indeed. Mr. Le Sueur cannot but hold this opinion, however careful he may be in expressing it. There is not one case in existence wherein these special qualities, light and definition, have coincided. In the official report of 31st December 1869 it is stated that "when favourably situated, Neptune was observed on many occasions for examination of figure, and the detection of new satellites with negative results in both cases." Is it to be inferred that Neptune had no figure, and that it had no satellite; or could neither one or other be seen by the aid of the great Melbourne telescope? The results were negative, because the tremendous aberration of the instrument would not give any image of the figure of Neptune. It should be remembered that Neptune was discovered by Lassell with a 2-foot aperture Newtonian. The good light of a 2-foot showed this body, and since then the large refractors have done all the finer observations. The report refers to certain spectroscopic work done with the instrument on the star *eta* Argo; but this could be done with any ordinary instrument, as it only deals with the light and not with the image. The report also says that one of the mirrors was never good, and became very dull from a peculiar kind of yellow tarnish; but the other is much better, "and the performance now is far more satisfactory." All this vague language is extremely unsatisfactory, and it is very remarkable that the two mirrors, the same in all respects, should have been unequally tarnished by atmospheric causes. The telescope, possessed of tremendous aberration and distortion, is yet considered equal to the task of mapping the nebulæ. In fact, though it would shew Saturn as a cart-wheel, we are to be told that it is not intended for this kind of work, and that its mission is to plunge into space, to see that which no smaller aperture could see, and to map these delicate objects for the enhancement of science. There are some serious questions in connection with this subject. Have the large reflectors given us the true forms of the various nebulæ? Are we to expect that the great Melbourne telescope will

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give us the same forms for the nebulæ as the Rosse? No such thing. Every large reflector, owing to aberration and distortion, gives a very different view of the same nebula. The difference is not due to light power, but to mechanical errors. If they shew Saturn as a cart-wheel, is a nebula, as regards form, not also a cart-wheel? We are sensible from previous observation of the form of a known body, such as Saturn, and therefore we are obliged to admit that the instrument is unfit for that sort of work; but we are, on the other hand, ignorant of the real true forms of the nebulæ, and hence fashion and the vanity of our countrymen—not science—have led more than one astronomer to suppose that he sees that which he really wishes to see, when observing through a large aperture reflector. Thus it is very doubtful if the nebula around *eta* Argo has really undergone any transformation, or the one imputed to it by Mr. Le Sueur, since it was observed by Sir John Herschel at the Cape in 1838. The Melbourne authorities stated that the position of the star *Eta* had undergone considerable changes since that period; also that the curious dark-shaped vacuity in the centre of the nebula had changed, and that the sharp edge thereof had been softened down. This observation depends much more upon the definition of the telescope than its light power. Hence the danger of announcing such an observation, when taken by the Melbourne telescope. This observation was taken about October 1869. It is at least very remarkable to find Sir John Herschel, in the latest edition of his *Outlines*, saying: "By a letter from Mr. E. B. Powell, of Madras, an observer of too much experience to be easily deceived, or to speak on light grounds, I am informed that the southern end of the very remarkable lemniscate-shaped vacuity, close to the bright central star in the nebula about *eta* Argus, which was closed and terminated by a strong and sharply-cut outline, is now decidedly open. More recent observations, however, by Lieutenant J. Herschel, with an achromatic telescope of five inches aperture, accompanied with careful drawings of the appearance of the nebula taken on the 22nd and 23rd November 1868, make it evident, 1st, that the lemniscate still exists as such, though, as might be expected, not so strongly defined as when seen with an instrument of superior power; 2nd, that the relative situations of 48 out of 49 stars in the immediate vicinity have undergone no material change, the 49th being a very minute star of doubtful identity; and, lastly, that the principal star *Eta* itself, though greatly diminished in lustre, occupies most decidedly its old situation, pretty deeply immersed in the brightest portions of the nebula on the following, or eastern side of the lemniscate; and not, as stated in the last edition of this work, on what he considered sufficient authority, within the lemniscate or its remains, and out of the nebulosity." It is evident that inasmuch as these observations were taken within eight or nine months of each other, they both cannot be right. It is out of the question to suppose the change in the nebula to have taken place during the short interval of nine months, and therefore we are driven to consider which observation deserves the most confidence. Lieut. Herschel was aided with a very superior refracting telescope of five inches aperture supplied by the Royal Society, and he was moreover specially prepared to examine this object. On the other hand, Mr. Le Sueur was merely experimenting with a telescope whose powers were quite unknown—at least its errors were not understood—and which is now known to have powers of a very indifferent character. There are grave doubts that Mr. Le Sueur's discovery was simply due to the aberration and distortion of the instrument. In order that his statements and arguments adduced may not be misunderstood, Mr. Severn concluded by a recapitulation of what he affirms:—(1.) That the choice of a reflector was an error.

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(2.) That the theory by Dr. Robinson and Mr. Grubb, that it would require a 34-inch refractor to equal the 4-foot Melbourne reflector, is practically wrong. (3.) That the Newtonian form of telescope is far better than the Cassegrain. (4.) That the telescope has never been in a perfect state in this country, or equal to the work it is said to have done in Ireland. (5.) The colony has paid for an instrument having a 4-foot aperture, but from aberration and distortion the light power is reduced to about one-third of the aperture. (6.) That the perfect completion of the specula in a cold climate, for ultimate use in a warm one, was calculated to render them unfit for astronomical work. (7.) That the specula will soon be unfit for use; one is so already, not on account of tarnish, but on account of aberration. (8) The higher powers are all useless on account of aberration. (9.) The telescope has no definition, notwithstanding the statements to the contrary. It cannot with a low power even show the discs of Jupiter's moons. (10.) It cannot concentrate its light; hence it is not useful as a 4-foot for nebula work. (11.) It is no match whatever for a 12 or 14-inch achromatic, which could have been obtained for less money.

After reading his paper, Mr. Severn made a few observations, remarking that his great object was to have the point settled whether or not there had been an aberration in the reflectors.

Mr. Le Sueur said that Mr. Severn seemed to assume, as a foregone conclusion, that the telescope had been a failure. It was not so. Great telescopes always had more deviation than small ones, but he desired to state that the Melbourne telescope had no further aberration than the others of like magnitude. Mr. Severn had misapprehended the statements in the Observatory report with respect to the observation of Neptune. The telescope showed the disc of the planet well, and also its well-known satellite. His object had, however, been to look for another satellite, and by negative results he meant that he saw nothing beyond what had already been discovered. (Mr. Le Sueur also replied to Mr. Severn's criticisms on *eta* Argus, illustrating his reply by a diagram on the black-board.) Mr. Severn spoke of an aberration of two or three feet in reflectors. For his own part he could not imagine an aberration of more than two or three inches, unless the reflectors were positively hammered out of shape. The actual aberration of the combined reflectors in the great Melbourne telescope was not more than half-an-inch. He had taken observations with the telescope every day while it was in Ireland, and he declared that it was exactly in the same state now as then. Mr. Severn overlooked altogether the effect of the atmosphere in causing deviations. In his observations with the Melbourne telescope, he had seen a deviation perfectly abominable at one time, and half-an-hour afterwards he had obtained a splendid image. The telescope was probably as perfect as any of the size ever was, or ever could be. It was a fact that he entertained and had expressed a preference for the Newtonian over the Cassegrain construction; but he was not certain whether this was worthy of being dignified with any other name than a hobby. The power now used for ordinary nebular work with the telescope was about 240, but it was increased up to 950 when occasion required.

Mr. Ellery disagreed with Mr. Severn on many points, and particularly in his statement as to the effects of change of temperature on the reflectors. The temperature did not exercise the influence described by Mr. Severn, except when the metal was notoriously bad. He believed that the telescope was well fitted for the nebular work it was required to perform. The night that Mr. Severn examined Jupiter's satellites and the nebulæ through

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it, was a particularly unfavourable one. This he remembered, because the same night he had invited other persons to look through the telescope, and on observing with it himself he found the images were bad. A night or two afterwards he viewed Jupiter's satellites through the telescope, and it defined admirably.

Mr. White, of the Observatory, also considered that the telescope proved of great value with the nebular work.

Dr. Crooke said the question was, not whether the telescope was better or worse than others like it, but whether a mistake had not been made in getting it at all.

Mr. Le Sueur did not think much good would be gained by discussing that now.

Mr. Ellery remarked on one other point. Mr. Severn had compared reflecting with refracting telescopes. It was an indisputable fact that the best refractors fell far short of the reflectors in the definition of nebulæ.

Mr. Severn called the statement in question, and declared that Bond's refractor of 14-inch aperture surpassed the Rosse reflector in this very work.

Mr. Gibbons then moved the adjournment of the discussion until the next night of meeting, and this was agreed to, whereupon the members separated.

[In our next number we shall give the official Report as to the Telescope, and other remarks on the same subject.—Ed.]

A DAYLIGHT OBSERVATION OF METEORS.

By C. Grover, Assistant to John Browning, Esq., F.R.A.S.

Many of the readers of the *Register* were gratified with a sight of the meteoric shower of the morning of November 14th, 1866; and we think we may quite safely count upon expressing the general opinion of those so favoured, if we describe it as one of the most magnificent and impressive, and certainly one of the most widely observed celestial appearances of the present generation.

Occurrences of this character, which can be gazed at by the most unlearned, and without any instrumental appliances, excite the admiration of admiring millions of our countrymen and create a certain amount of interest, which is, however, of the most transient character, and entirely different from the long-continued and laborious investigations of those profound thinkers who have made this branch of scientific research their especial study. To their zeal and perseverance we are indebted for a considerable amount in the most interesting information and speculation as to the position in our solar system, motions, radiant points, and physical constitution of these marvellous bodies.

There is something grandly impressive in the swift but generally silent course of a brilliant meteor, especially when observed in the stillness of the midnight hours. At such times, when the stars look down in their greatest brilliancy on the slumbering world, and the celestial concave *appears* in its greatest glory, the attention of the telescopic observer is frequently arrested

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by a flash of light at once so brilliant and startling as to cause the eye to be withdrawn from the telescope, just in time to observe the transient visitor finish his course in utter darkness or burst into a shower of sparks, leaving behind a slowly vanishing phosphorescent track, in either case affording a striking contrast to the everlasting stars which we are accustomed to contemplate with pleasure, as they year by year present their annual configurations.

The object of the present paper, however, is not to dilate on the beauty of these objects when seen in the nocturnal sky, but to describe as clearly and concisely as possible their appearance as seen by day in the full blaze of the solar splendour. The particulars of this curious and somewhat rare phenomenon are best laid before the reader in the exact words of the Observatory note-book, the entry from which I now proceed to copy.

1870, July 24, 10h. 15m. A.M.—The morning being very fine I directed the 12¼ equatorial silvered glass reflector to the planet Venus, which then preceded the Sun by about two hours. After noting, as is usually the case, the absence of any markings or irregularities on the disc, excepting the usual fading off of the light towards the terminator, I proceeded to observe the planet Mercury, and on adjusting the instrument accordingly, I found the planet was very near the Sun, in fact there was but about 3 minutes of right ascension and 2 degrees of declination between the two bodies, and as I was using at the time a comet eye-piece of low power, with a field of about a degree and a half, the Sun's limb was but just outside the field, which was consequently intensely illuminated. I had scarcely time to think of the small chance of being able to pick up the planet under these circumstances, when a conspicuous but ill-defined luminous object sailed across the field of view. Thinking that this might be the planet, as I had left the telescope free in R.A., I proceeded to clamp it for further examination, when to my astonishment the appearance was repeated, and in a very few minutes fully twenty of these bodies had passed my field of vision. As may be expected, so surprising an appearance at once arrested my attention, and I proceeded at once to adjust the focus of the telescope for distinct vision. This required the drawing out of the eye-tube nearly half an inch, thus clearly showing the objects observed to be much nearer to us than the Sun itself, and at the same time dispelled all doubt as to their true character, since they exhibited, in most cases, a sharply-defined disc, a few of the largest appearing rather irregular, while in all cases the emission of sparks, and an evident appearance of intense combustion, was distinctly visible; but in no case was there any trace of a tail or train such as is the usual appendage of a meteor as seen in the night sky.

As the shower steadily continued I had an abundant opportunity to guard against the least possible optical delusion, and to deliberately study in detail the appearances presented. I found a great variety in size, from mere points to bodies fully equal in apparent diameter to the planet Jupiter, as seen with the same power. A very marked yellow colour pervaded the whole, and the brilliancy was very striking, especially in the case of the larger meteors, which as they sailed across the field of view caused a distinct glare: this was all the more marvellous when the proximity of the Sun and consequent intense illumination of this part of the heavens was taken into consideration.

The direction of motion (a most important element in such observations) was well attended to; and from a most careful estimation I found them cross the field from 140° to 340°, the motion in all cases being the same; and they were so numerous that I was several times able to certainly count ten as visible at one time in the field of one and a half degrees in diameter, and but a few seconds elapsed during the half-hour I continued observing

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without the passage of three or four. This peculiarity of successive flights of meteors was a well-observed feature of the grand display of 1866.

It will no doubt occur to the mind of many of the readers of this article, that here was a fine opportunity for observing any phenomena which might be caused by the transit of these bodies across the Sun's disc, but it unfortunately happened that I had not the solar eye-piece at hand, and the opportunity was consequently lost. Sufficient has been seen to furnish ample material for a considerable amount of speculation and study; this, however, I leave to more able hands, to whom I hope my observations may not be without interest.

CORRESPONDENCE.

N.B.—We do not hold ourselves answerable for any opinions expressed by our correspondents.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

SPECTRUM OF THE MOON.

Sir,—In accordance with Captain Noble's request, I append an extract from my note-book on the spectrum of the Moon, observed during the eclipse. From these notes, it will be seen that, although I used a reflector of 12-in. aperture, I found the light too feeble to enable me to do any useful work with the instrument.

I am, Sir, yours truly,

Clapham: Sept. 5, 1870. JOHN BROWNING.

"Circumstances prevented me from attempting a careful measurement of the absorption lines in the spectrum, specially due to vapour. These were easily recognised on the comparatively bright portions of the moon's surface, but during the time of total obscuration I could not well obtain any of these lines with sufficient sharpness to even make a drawing of them, though I used a reflecting telescope of above 12-in. aperture, and the telescope of the spectroscope only magnified between two and three diameters. I used a very wide slit. The spectrum seen in this manner at the time of total obscuration consisted only of the red and orange portions of the spectrum, with a mere trace of the green, not, I think, extending as far as little B. A large number of cloudy bands from B to between C and D were visible. On any attempt to close the slit sufficiently to produce sharp definition, the spectrum became so dark, that the bands themselves were lost to view."

SUN-SPOT PERIOD.

Sir,—In your August number I notice a letter from Mr. Buffham in reference to a possible connection between the present appearance of Jupiter and the sun-spot maximum.

Sir W. Herschel observed unusual changes in Jupiter in Jan. 1790, and Mr. Buffham adds, "If we take Woolf's date for solar spots, 1836, the year of maximum, deducting four periods of 11·2 years each, we arrive at 1791 as a maximum period, which is very near the date of Sir William's observation."

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This would seem to show that the observation was made a year or so before the maximum, but it was in fact after the maximum had passed. It is worthy of note, in fact it should never be forgotten, that there is no 11-year period of sun-spots in nature. The period is variable, being sometimes more, sometimes less; the average is about $11\frac{1}{6}$ years; some periods have been but 8, others have reached 16 years. It is important, then, in the observations of change, planetary or meteorological, to take the real and not the mean time of maximum or minimum of sun-spots.

The following table may be useful to some of your readers (from Woolf):—

Max.	Min.	Toronto rainfall.
1750·0	1755·7	
1761·5	1766·5	
1770·0	1775·8	
1779·5	1784·8	
1785·5	1798·5	
1804·0	1810·5	
1816·8	1823·2	
1829·5	1833·8	
1837·2	1844·0	16
1848·6	1856·2	21
1860·5	1867·0	19

I might notice whilst on this subject that a remarkable coincidence seems to exist between sun-spot minimum and rainfall at Toronto. The average of 21 years is a trifle more than 30·1 inches, yet at the last three minimum years it stood thus—

1844 16 inches 1856 21 inches 1867 19 inches.

I am, Sir, yours, &c.

Toronto: Aug. 19. A. ELVINS.

P.S.—Will some of your readers tell us how the rainfall stood in their locality during those years, and give the average amount also?

AURORA.—At 11h. 30m. on the 20th August, while pointing the equatorial to the northern sky, the beautiful beams of the aurora were seen through the slit in the dome of the observatory. The phenomenon was watched until 3 A.M. on the 21st, and the following notes were made at the time. 11h. 30m. Greenwich M. T.—On the N. horizon lay two black bands of cloud: above these, and extending to an altitude of 15°, there was a patch of comparatively dark sky, but the stars were seen through this dark haze. From 15° to 30° of altitude the sky was lit up by the luminous arch. It was fairly defined at its upper edge, extended from E. to W., but showed no trace of the lovely rose tints sometimes seen. The fine, broad, dense, bright beams which shot upwards beyond the zenith, had their origin, not in the horizon, but in the gloom above the dark bands of cloud. Here it was that the intensity was greatest and most striking. Near and beyond the zenith the light of the beams grew faint. Those at the W. end of the arch ascended to α Lyræ, and here too the beams were brightest. No palpitating motion was seen: they shone with a comparatively steady light: they were slightly inclined to the E. But few beams were seen at the eastern extremity of the arc, and they were never bright. The most eastern one has its apex near α Persei.—11h. 45m. Now the display was most brilliant. The bright, broad bands now moved eastwards, and in 10m. they had passed from α Ursæ Majoris to the eastern end of the arch,

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gradually becoming fainter as they advanced. Some of these luminous columns were 5°, and others 7° in width, while the fine band which led the advance to the east was some 40° in breadth. At 12h. the display was much fainter: single beams still shot upwards here and there, but they were neither brilliant nor numerous. There was not the usual incessant upward shooting of the beams: they lay comparatively still. There was no trace of luminous patches or beams to the south of the zenith. At this time and since 11h. 45m. three detached small dark clouds were seen moving slowly from the east across the bright arch of the aurora.

At 2 A.M. on the 21st the phenomenon appeared again, but with diminished splendour. Again the movement of the brightest beams from W. to E. was observed. Cloud now began to gather and obscure the northern sky.

At 3 A.M. the sky was bright in the north, but much cloud was gathering in the E.

The night was calm, cool, and fine. About 5 A.M. the thermometer on the grass fell to 32°.

Another exhibition of aurora was observed here on the 3rd of September. At 8 P.M. the sky in the NNW. and W. was unusually bright: the brightness in the NE. and E. was much less. At the highest point this luminous region did not extend to a greater altitude than the stars β and γ Ursæ Majoris. The sky was often free from cloud in the W. and S. and N., but dark masses occasionally passed from the W. In the eastern sky long, delicate, diverging lines of white cloud had been seen for an hour.

At 8 o'clock they were very beautiful, being composed of short, close, narrow streaks lying parallel to one another but at right angles to the direction of the long beam. These clouds, while under view, rapidly lost their structure and became long diverging lines of white haze. The point from which they diverged was about NE. and on the horizon. Some of them reached the zenith, one touched α Lyræ, and another α Aquilæ. At 9 P.M. bright auroral beams shot up in the NW., but none were seen in the E. Dense clouds again covered the northern sky, and at 10 P.M. nothing remained but the bright region under the Great Bear. In the NE., however, one of the low clouds was lit up with a soft rose tinge for a few minutes.

The wind, which had been pretty high all day, fell early in the evening.

Mr. Crossley's Observatory, Halifax. JOSEPH GLEDHILL, F.G.S., F.M.S.

SIR ISAAC NEWTON'S OBSERVATORY.—A proposal is made to purchase Sir Isaac Newton's Observatory, which can be obtained for the comparatively reasonable sum of 330 guineas, and to present it to the nation as Shakespeare's house was, but with this difference—that the latter cost thousands, and can only be seen at Stratford-on Avon. But the Newton Observatory, being in London, could be seen by most people. Such a priceless object, the studio of one of the greatest men that ever lived, we hope will be speedily secured by the public coming forward promptly with their subscriptions, and thus securing an invaluable relic. A good view of its interior is in the *Illustrated London News* of July 24, 1858. Prince Albert visited it twice. It was his Royal Highness who originally suggested its purchase. Sir R. Murchison, Bart., &c., has subscribed to the fund, and promised to recommend it.—*Standard.*

THE office of Government Astronomer at Sydney, New South Wales, is vacant by the death of Mr. George K. Smalley, B.A., F.R.A.S.

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It is of the annual value of 600*l.*, and is in the gift of the Premier of the colony.

THE SOLAR ECLIPSE OF DECEMBER NEXT:—The refusal of the Admiralty to allow the use of a ship for the proposed Eclipse expeditions to Gibraltar and Syracuse has made a painful impression in scientific circles. We can scarcely believe that this refusal will not, even now, be reconsidered. The progress of recent scientific research into the subject of solar physics had left one great problem still unsolved, and astronomers hoped to solve that problem during the course of the total solar eclipse of December 24th next. To this end no less than 60 students of science had offered their services. The journey to Gibraltar or Syracuse would have involved considerable personal inconvenience to all these volunteers in the cause of science; many of them would have incurred no unimportant pecuniary expenses in carrying out their proposed plans; and to not a few the mere amount of time necessarily sacrificed during the voyage would have been in effect a pecuniary sacrifice. Yet in the interests of scientific progress all these gentlemen had been willing to join the expedition. And now, by what must seem until explained a paltry parsimony, the means of transport, which could have cost the country little by comparison with the sacrifices made by individuals, are refused to both the expeditions. It is easy to renew the old *cui bono* argument; to ask what material profit the country can gain from the determination of the nature of the sun's corona. As respects pounds, shillings, and pence, the great problem of solar physics makes rather a poor figure. But England has not hitherto been in the habit of so strictly measuring the interest of scientific researches by the money standard. More than a century ago the country was willing to pay for the expense of voyages to the Antipodes, undertaken to solve a problem of no greater interest than that which our observers had hoped to attack next December. Captain Cook and his companions encountered all the perils of a voyage of circumnavigation in order to make observations (such at least was the primary purpose of the expedition) intended to inform men whether the sun is 90 or 95 millions of miles from us, a matter of no commercial moment whatever, not even associated in the most remote degree with the astronomy which serves our seamen and geographers. Yet again, a handsome sum (let us gather comfort at least from this) has been granted for observations of a like character four years hence. The Antarctic seas will be traversed in 1874 to solve that same problem of the sun's distance which has so little commercial moment, yet interests us all so much. Why a phenomenon which occurs at a distance so much more convenient, which bears on a problem at least as interesting, and to observe which so many eminent men had offered their services, should thus be despised by the Admiralty, it would be difficult to say. It can scarcely be that the war has disturbed men's minds too much to allow of a single steamer being despatched to the Mediterranean. England has not hitherto shrunk from scientific investigations for such reasons. In the most agitated period of the French Revolution, Delambre and Mechain measured the arc of the meridian between Dunkirk and Barcelona, and they completed their work though France was then being invaded, and though at every station of their progress the peasantry were ready to arrest them as hostile spies. Truly we hope no shame will be suffered to fall upon the scientific repute of England, but we fear greatly that this will happen unless an earnest effort is made to obtain from the Admiralty the reversal of their decree against science. Let us note, in conclusion, that no such opportunity for observing the eclipsed sun, at European stations, will occur for several years to come.—*Daily News.*

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THE AUGUST METEORS.—On the morning of July 31, a few minutes past 12, I looked out at the sky and saw a bright meteor, moving out from Perseus. I continued watching for 15 minutes, during which time I saw 13 meteors. Nine radiated from Perseus, and four crossed the zenith or near it, moving in parallel lines, eastward; the last four could not have been of the August group, but the nine doubtless were, as they certainly radiated from Perseus. They were seen from 12h. to 12h. 15m. on the morning of 31st July. A. E.

CALCULATION OF ECLIPSES.—*Curiosus* would be glad to be told of some astronomical tables for the calculation of eclipses, avoiding the numerous equations that most contain. He has Ferguson's tables and Snooke's *Brief Astronomical Tables for the Expeditious Calculation of Eclipses*; publisher, Highley, Fleet Street, 1852. The latter would be of value if they gave any method for projecting solar eclipses, which they do not, and Ferguson's method will not answer for them. Ferguson's tables are antiquated.

Astronomicus will find in the *Astronomical Register*, No. 76, April 1869, a letter from Mr. Hind about the solar eclipse of August 1887: the elements are there given; so that the circumstances of the eclipse may be calculated for any place required. Mr. Hind says, "the zone of totality does not reach our shores." G. J. W.

THE PLANET NEPTUNE.—A triangle formed by ν, o, and μ Piscium (5th magnitude stars) is easily identified. Close above μ are 96 and 85, all in a line, and Neptune is a little to the right of 96, moving slowly in the direction of the little triangle formed by 80, 73, and 77. A low power shews μ, 96, 85, and the planet in the same field: a good opera-glass will do so on a clear night. Further information, if wanted, will be given by enclosing a postage stamp to

GEORGE J. WALKER, Teignmouth, South Devon.

LUNAR MAP AND CATALOGUE.—We are informed that a Monogram of "Hipparchus," on a scale of 100 inches to the Moon's diameter, is in course of delivery to subscribers for the *second* year; also that the fourth area of the map, on the scale of 200 inches to the Moon's diameter, is now ready. While passing through the press the greatest attention has been bestowed on these portions of the work, with a view to embody the results of the most recent inquiries into the physical state of the Moon's surface, comprised between 0° and 10° of south latitude, and 0° and 10° of west longitude. The number of separate objects that have been detected within this space is 474, of which 115 are found in and near *Hipparchus*.

Materials for a Monogram of the Mare Nectaris are in process of collection and arrangement. The drawing of Professor Phillips, in Phil. Trans. 1868, will form the basis for the outline of the group, Theophilus, Cyrillus, and Catharina.—Mr. Birt has now left town to attend the meeting of the British Association at Liverpool.

CHEAP OBJECT-GLASSES.—Sir, I am about to get a telescope, but seeing certain advertisements of object-glasses at low prices, I should like to know if you would advise me to make my own telescope. I have two lists: in the first the advertised prices of object-glasses are, 3-inch, 2*l.* 2*s.*; 3¾-inch, 5*l.* 10*s.*; 5¼-inch, 25*l.*: in the second list, I find 3-inch, 1*l.* 17*s.* 6*d.*; 3¾-inch, 4*l.* 17*s.* 6*d.*; 5¼-inch, 17*l.* 10*s.* Can any dependence be placed on the performance of these object-glasses, for if so, how about the high price usually asked for telescopes of 3 inches diameter and up-

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wards? Perhaps some correspondent would throw light on the matter, and thus oblige and assist

London: September 1870. A BEGINNER.

We have to acknowledge the receipt from the Author of the following: 'Path of the large Fireball of November 6, 1869.' By Professor A. S. Herschel. From the proceedings of the Meteorological Society.

ASTRONOMICAL CLOCK AT STRASBURG.—The following particulars concerning this remarkable clock, said to have been lately destroyed by the bombardment, are from the *English Cyclopædia*, 1855. It stood in the south transept of the cathedral, and was made in 1571. After going for about 200 years, it went out of order, and remained useless for nearly 50 years: it was repaired a few years ago by a watch-maker of the town, and still maintains its character as a most elaborately finished, complicated, and surprising piece of machinery.—[From later information it appears that this valuable clock has escaped injury up to the present time, Sept. 26.—ED.]

THE PLANETS FOR OCTOBER.

AT TRANSIT OVER THE MERIDIAN OF GREENWICH.

Planets	Date	Right Ascension	Declination	Diameter	Meridian Passage
		h. m. s.	° ′		h. m.
					0 6·6
Mercury	1st	12 46 43	−8 9½	10″·2	23 59·0
	15th	12 21 54	0 48	7″·7	22 42·9
Venus	1st	11 33 51	+4 24	10″·2	22 50·0
	15th	12 37 58	−2 29½	10″·0	22 58·9
Mars	15th	9 42 14	+15 17½	6″·0	20 3·7
Jupiter	1st	5 43 28	+22 50	39″·0	17 0·6
	15th	5 44 38	22 50½	40″·6	16 6·7
Saturn	1st	17 29 31	−22 16½	14″·6	4 48·7
Neptune	4th	1 19 0	+6 28½	—	12 25·1
	20th	1 17 20	6 18½	—	11 20·5

Mercury arrives at inferior conjunction on the 3rd of this month, having passed the meridian twice on the 1st at six minutes after noon, and at one minute before noon on the 2nd. The planet is nearly three degrees below

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the Sun at this time. It reaches its greatest westerly elongation on the 19th, passing the meridian about one hour and twenty minutes before noon. During the latter part of October it is favourably situated for observation in the morning, its declination being greater than that of the Sun. It is very near the equator in the middle of the month.

Venus continues to approach the Sun, the diameter of the planet decreasing each month; as a telescopic object, of use only to ascertain how near she can be seen to the Sun. The planet passes the meridian shortly before 11 o'clock in the morning at the beginning of October, and about ten minutes past 11 at the end of the month. The planet crosses the equator about the 10th of October.

Mars passes the meridian about half-past 7 in the morning at the end of the month, and may consequently be seen in the early morning, but the planet is far too small to repay observation.

Jupiter is now a conspicuous object in the north-east sky in the later part of the night. The planet passes the meridian about 5 o'clock in the morning at the beginning of October, and about 3 o'clock at the end of the month.

Saturn may still be observed in the west in the early part of the evenings at the beginning of this month, but is now passing away for the present year.

Neptune arrives at opposition this month, and is therefore most favourably situated for observation. The planet is about 6½ degrees north of the equator.

The minor planet **Vesta** arrives at opposition on the 18th of this month. The following will be the positions occupied at transit, and will enable her to be found. This planet is at opposition about the 7th magnitude.

		Right Ascension.				Declination South.	
		h.	m.	s.		°	′
October 10	...	1	57	21	...	0	23
12	...	1	55	30	...	0	34
14	...	1	53	36	...	0	44
16	...	1	51	41	...	0	54½
18	...	1	49	45	...	1	4
20	...	1	47	49	...	1	13
22	...	1	45	52	...	1	21½
24	...	1	43	57	...	1	29½

Meridian passage:—Oct. 8th, 12 49·4; 18th, 12 0·7; 28th, 11 11·8.

ASTRONOMICAL REGISTER—Subscriptions received by the Editor.

To December 1869.
Bazley, T. S.

To June 1870.
Howlett, Rev. F.

To September 1870.
Elliott, R.
Ormesher, H.

To November 1870.
Linwood, Rev. W.

To March 1871.
Mills, E. B.

To June 1871.
Main, Rev. R.

To September 1871.
Coulcher, M. W. B.

September 22, 1870. Subscriptions after this date in our next.

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ASTRONOMICAL OCCURRENCES FOR OCT. 1870.

DATE		Principal Occurrences		Jupiter's Satellites		Meridian Passage
		h. m.			h. m. s.	h. m. Moon —
			Sidereal Time at Mean Noon, 12 40 3·9			
Sat	1	9 19	☽ Moon's First Quarter	1st Ec. D.	14 20 16	5 47·0
		6 41	Occultation of B.A.C. 6343 (6)	„ Oc. R.	17. 51	
		7 45	Reappearance of ditto			
Sun	2			1st Sh. I.	11 36	6 44·0
				„ Tr. I.	12 54	
				„ Sh. E.	13 50	
				„ Tr. E.	15 9	
Mon	3	17 33	Inferior Conjunction of Mercury	1st Ec. D.	8 48 37	7 38·6
				„ Oc. R.	12 19	
				2nd Sh. I.	13 20	
				„ Sh. E.	15 54	
				„ Tr. I.	15 58	
Tues	4			1st Tr. E.	9 37	8 30·3
Wed	5		Meridian Passage of the Sun, 11m. 33s. before Mean Noon	2nd Ec. R.	10 51 8	9 19·0
				„ Oc. D.	10 55	
				„ Oc. R.	13 31	
Thur	6	13 42	Occultation of ψ Aquarii (5)			10 4·9
		14 44	Reappearance of ditto			
Fri	7	11 20	Near approach of Moon to 30 Piscium (5)	3rd Ec. D.	13 22 53	10 48·6
				„ Ec. R.	15 37 9	
Sat	8			1st Ec. D.	16 13 43	11 31·0
Sun	9	1 43	○ Full Moon	1st Sh. I.	13 30	12 12·7
				„ Tr. I.	14 45	
				„ Sh. E.	15 44	
				„ Tr. E.	17 0	
Mon	10			1st Ec. D.	10 42 4	Neptune —
				„ Oc. R.	14 9	
				2nd Sh. I.	15 55	12 0·8
Tues	11	11 0	Conjunction of Venus and Mercury, 1° 11′ S.	3rd Tr. I.	8 21	11 56·8
				1st Tr. I.	9 13	
				„ Sh. E.	10 13	
				3rd Tr. E.	10 49	
				1st Tr. E.	11 27	
Wed	12		Saturn's Ring: Major Axis = 35″·8 Minor Axis = 16″·3	1st Oc. R.	8 36	11 52·8
				2nd Ec. D.	10 57 9	
				„ Oc. R.	16 1	
Thur	13	11 12	Opposition of Neptune			11 48·7
Fri	14	16 33	Occultation of ζ Tauri (3½)			11 44·7
		17 55	Reappearance of ditto	2nd Tr. E.	10 15	
		23 45	Conjunction of Moon and Jupiter, 0° 55′ N.	3rd Ec. D.	17 21 51	
Sat	15		Illuminated portion of disk of Venus = 0·974 of Mars = 0·924	1st Ec. D.	18 7 13	11 40·7

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DATE		Principal Occurrences		Jupiter's Satellites		Meridian Passage
		h. m.			h. m. s.	h. m. Neptune —
Sun	16	12 24 15 41	Sidereal Time at Mean Noon, 13 39 12·2 Occultation of δ Geminorum (3½) Reappearance of ditto	1st Sh. I. „ Tr. I. „ Sh. E.	15 24 16 35 17 38	11 36·6
Mon	17	6 13 10 30	☾ Moon's Last Quarter Conjunction of Moon and Uranus, 0° 38′ S.	1st Ec. D. „ Oc. R. 2nd Sh. I.	12 35 35 15 58 18 29	11 32·6
Tues	18			3rd Sh. E. 1st Sh. I. „ Tr. I. 3rd Tr. I. 1st Sh. E. „ Tr. E. 3rd Tr. E.	9 49 9 52 11 2 12 3 12 7 13 17 14 31	11 28·6
Wed	19	4 30 13 38	Greatest Westerly elongation of Mercury 18° 12′ Conjunction of Moon and Mars, 1° 57′ S.	1st Oc. R. 2nd Ec. D. „ Oc. R.	10 25 13 33 23 18 27	11 24·5
Thur	20			1st Tr. E.	7 44	11 20·5
Fri	21		Meridian passage of the Sun, 15m. 17s. before Mean Noon	2nd Sh. I. „ Tr. I. „ Sh. E.	7 46 10 3 10 21	11 16·5
Sat	22	19 47	Conjunction of Moon and Mercury, 3 12′ S.			11 12·4
Sun	23	6 0	Conjunction of Moon and Venus, 3° 55′ S.	2nd Oc. R. 1st Sh. I. „ Tr. I.	7 40 17 18 18 24	11 8·4
Mon	24	3 36	● New Moon	1st Ec. D. „ Oc. R.	14 29 11 17 46	11 4·4
Tues	25			3rd Sh. I. 1st Sh. I. „ Tr. I. 3rd Sh. E. 1st Sh. E. „ Tr. E. 3rd Tr. I. „ Tr. E.	11 20 11 46 12 51 13 49 14 1 15 5 15 40 18 8	11 0·3
Wed	26			1st Ec. D. „ Oc. R. 2nd Ec. D.	8 57 38 12 13 16 9 33	10 56·3
Thur	27	17 31	Conjunction of Moon and Saturn, 0° 36′ S.	1st Tr. I. „ Sh. E. „ Tr. E.	7 18 8 30 9 32	10 52·3
Fri	28			2nd Sh. I. „ Tr. I. „ Sh. E. „ Tr. E.	10 20 12 24 12 56 15 1	Moon — 3 36·9
Sat	29			3rd Oc. R.	7 49	4 36·5
Sun	30	6 30 11 48 20 1	Near approach of Moon to 4 Capricorni (6) Conjunction of Mars and Regulus, 13m.·2 W. ☽ Moon's First Quarter	2nd Oc. R.	10 3	5 33·6
Mon	31			1st Ec. D.	16 22 52	6 27.3

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D'ARREST'S COMET.

Sir,—The following Ephemeris of this body for the month of October will be useful to some of your readers.

Berlin Mean Moon.

1870.		R.A. h.	m.	s.		N.P.D. °	′
October 1	...	18	21	21	...	113	10
3	...	18	29	27	...	113	47
5	...	18	37	41	...	114	21
7	...	18	46	1	...	114	53
9	...	18	54	28	...	115	22
11	...	19	2	59	...	115	49
13	...	19	11	35	...	116	13
15	...	19	20	14	...	116	34
17	...	19	28	55	...	116	53
19	...	19	37	39	...	117	9
21	...	19	46	23	...	117	22
23	...	19	55	7	...	117	33
25	...	20	3	50	...	117	40
27	...	20	12	32	...	117	45
29	...	20	21	11	...	117	47
31	...	20	29	47	...	117	47

NEW COMET.—A small telescopic comet was discovered by M. Coggia at Marseilles on August 28. The following provisional elements are by M. Oppolzer of Vienna:

			°	′
T	=	Sept. 3·82		
π	=		8	45
Ω	=		12	54
ι	=		99	35
log q.	=		0·25912	

The following positions are supplied by the same calculator:—

1870.		R.A. h.	m.	s.		Decl. °	′
September 29	...	0	25	4	...	26	24
October 3	...	23	56	0	...	28	7
7	...	23	27	7	...	29	16

I remain, your obedient servant,

Windy hills Observatory, Bickley: Sept. 1870. G. F. CHAMBERS.

The Astronomical Register is intended to appear at the commencement of each month; the Subscription (including Postage) is fixed at **Three Shillings** per Quarter, *payable in advance*, by postage stamps or otherwise.

The pages of the *Astronomical Register* are open to all suitable communications. Letters, Articles for insertion, &c., must be sent to the Editor, Mr. S. GORTON, *Parnham House, Pembury Road, Clapton, N.E.*, **not later than the 15th of the month.**

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The Astronomical Register.

No. 95. NOVEMBER. 1870.

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THE OCCULTATION OF SATURN.

(SEPTEMBER 30.)

Observed by Mr. T. H. BUFFHAM, *Earith, Hunts.*

This phenomenon was observed with a 2·9-inch refractor, power 127, on the evening of September 30. Before the disappearance the crape ring across the ball was plainly distinguished, and I had glimpses of a dark belt, and the prominent features were all separately recognised as the ansa, space, ball, space and ansa passed out of sight behind the advancing but invisible dark limb of the Moon.

The image of the Moon at the reappearance was not quite so steady with the same power, but, carefully watching, I soon detected the planet, and presently was struck with the appearance of a very dark margin to the bright limb of the Moon, which maintained its exterior position and equable breadth of 3″ to 4″ until the planet had completely appeared from behind this unexpected addition to the occulting body. I am not quite certain, but think that this line was rather darker on the side contiguous to the Moon.

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This narrow line was not caused by any out-of-focus image, as Saturn, though dull and pale when compared with the Moon, was still defined with the focus previously adjusted on the latter. I am not aware whether any satisfactory explanation has been given of the cause of this exceptional appearance. If it were a matter of "personal equation," Mr. Dawes would probably have seen it at the occultation of Saturn in 1859, having previously observed it in 1857, when Jupiter was occulted. There would appear to be a difficulty in referring it to a lunar atmosphere, unless the latter were of such a nature as to be almost opaque, and very local. Is it possible that it is in some way connected with diffraction and interference? It may be well to remember that the sun was nearly vertical to that part of our satellite.

BRIGHT SPOTS ON JUPITER.

(October 10, 13h. 45m., G.M.T.)

Observed at Mr. Crossley's Observatory, Park Road, Halifax, by Joseph Gledhill, F.G.S., F.M.S.

The equatorial refractor, $9\frac{1}{3}$ inches aperture, with power 240, was used.

The night was calm, cloudless, and cold; the planet was very still, and the definition was good.

Streak No. 6 was now fully seen from limb to limb; it was very broad, rather dark, and sharply defined at the north and south edges. On this fine band five bright circular spots were conspicuous objects; they were nearly as bright as a satellite when it has just entered on the disc of the primary, and their diameter was a little more than 1″. That portion of the band which lay between the two nearest the centre was dark in one place and light in another. There was also a fine, bright round spot between bands 4 and 5. Band 5 was seen to be broken in the middle, the west end being thrown up to No. 6, and the east end resting on No. 4. At this time five beautiful festoons were seen under No. 4.

Brilliant Meteor.—A very fine Meteor was observed at Ashby-Brigg, Lincolnshire, by Mr. William Darby, on the evening of September 28, which appeared as large as Venus. Time about 7h. 20m. An observer at Bushey, Watford, saw what was doubtless the same, at 7h. 23m., and describes it as illuminating the sky as if by a magnesium light, and then bursting into three green and three white stars. The Rev J. C. Jackson, at Clapton, also saw this meteor; he gives the time as 7h. 30m., and describes it as falling in a vertical line between the tail of the Bear and Arcturus; its shape as of an elongated drop, and of an intense gold colour. It burst as it approached the horizon with a profusion of sparks.

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AURORA BOREALIS.

An unusual display of this phenomenon has taken place during the last two months. We have had the opportunity ourselves of observing several very fine instances of it, and have received several communications from our subscribers respecting it. We give the following :—

Aurora observed by Mr. JOSEPH GLEDHILL, *at Mr. Crossley's Observatory, Park Road, Halifax.*

(SEPT. 24, 8 P.M. to 4 A.M. ON SEPT. 25, 1870.)

At 8 P.M. on the 24th the northern sky was noticed as unusually bright, but no striking display of this beautiful phenomenon occurred until near 10 P.M.

At 10 P.M. the horizon from west to east was murky, but above β and γ Ursæ Majoris there was the bright auroral fringe along the arch formed by the dark sky below. Now and then faint broad beams of light shot out of the dark segment, and at ten minutes past ten the northern sky extending as far as Auriga, Perseus, Cassiopeia, Cygnus, and Lyra was lit up by the soft, fitful auroral light. The breadth of the bright arch where it passed through Ursa Major was about 10°. In half-an-hour the display was most brilliant. Massive beams lay side by side from west to east, stretching up to and beyond the zenith. Some were narrow and sharp in outline; other luminous columns were 10° in breadth near the base, while others, again, had an intensely bright central axis.

At the west end of the arch one magnificent streamer mounted to β and γ Lyræ, and at the east the summit of a fine beam reached to Capella. The soft, diffused light flashed from summit to summit, from the horizon to the zenith, and from east to west. In the region about the zenith the flashing to and fro of the light was beautiful in the extreme. A discharge would rush up from the dark segment in the west, expanding and brightening as it rose, sweep round to the zenith, and flash across to the top of another tall column from the east; then, serpent-like, a discharge would flash its course overhead, followed in a second by a similar lightning trail among the same stars; then a lovely rose tint glowed in the eastern and western sky; all would then disappear, leaving only a soft hazy light where all the bright glories had so lately shone. This scene reappeared before midnight, but was less beautiful. Thinking all was over I resumed my work at the equatorial, but at 12h. 30m., seeing that definition was suddenly impaired, I again looked to the north. Huge beams of light again were marshalled all along the horizon, side by side, from west to east, some being 15° in breadth, at an altitude of 30°. Their lofty summits shook and bent like drapery in a breeze, interlacing in the zenith. Here, again, was the glorious arch spanning the cloudless sky from horizon to horizon, through the zenith, Cassiopeia near the top.

Broad sheets of luminous cloud appeared and vanished like the summer lightning; short streaks and small patches flashed into view and played about the zenith, while the columns from the north threw out faint rays far away to the south, until Aries became the apex of the grand arch from south-west to north-east. Andromeda and Taurus were swept by these swift flashes.

At 1.15 A.M. Aries was surrounded by a gorgeous crown of light; short

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beams and patches of the white and ruddy light lay round this spot for more than ten minutes, while here and there a bright stream would shoot away far to the south.

At 1.30 the rosy glow burst out in the east.

At 1.40 the discharge was still fine in the north-west.

At 2 o'clock it was truly grand and beautiful beyond description. The northern sky, from west to east, up to the zenith, was one mass of bright, palpitating columns; of this all converged to the zenith, those from the extreme ends sweeping upwards in glorious arch, from Capella in the east, to the zenith, and on to the west.

At 2.40 and 3.40 fainter outbursts were seen, and at 4 A.M. the bright columns still shot up from the north.

Observed by the REV. S. J. JOHNSON, *Upton Helions Rectory, Devonshire.*

On the night of September 24 I observed a display of the aurora which must have been quite as splendid as those mentioned by Mr. Gledhill in the *Register* for October. At 9 P.M. a superb column sprang up from the north-west horizon, to the westward of Ursa Major, and about the width of γ and δ, in the tail of that constellation. This was of a beautiful green tint at the lower part, and higher up displayed a rosy colour. In about five minutes this column faded away, and then a similar one shot up for a short time a little to the westward of it. The heavens were brilliantly illuminated by the auroral light from Arcturus, which was then nearing the horizon, round to Capella in the north-east. I did not, however, notice any more streamers until 10.15, when the phenomenon became such as to strike the commonest observer. It gave one the idea of a distant fire. In the region between Capella and Ursa Major the aurora displayed a rich carmine colour; streamers shot up over this glorious red patch to a great height. At 10.20 one extended over the Pole Star and beyond it. There were two others parallel to it at the same time. This part of the heavens then seemed to get clear of the aurora, and a red column showed itself due west. This passed between δ Herculis and α Ophiuchi. Now came the most interesting part of the phenomenon, for about 10.40 bands of auroral light, parallel to the horizon, made their appearance in the north-west, flickering upwards just like puffs of white smoke, passing over many degrees of the sky in a second of time. By 11.40 the aurora had become quite inconspicuous. The heavens were slightly illuminated the following night.

The Aurora of the 24th was also observed by Mr. A. E. Barrett, of Grimston, Lynn, Norfolk, who saw a column of rosy tint ascending up to Alpha Lyræ.

There was again a brilliant display of Aurora on the following evening, the 25th Sept. This was well seen by the Editor of the *Register* and Mr. W. L. Lancaster, at Clapton, while engaged in observing with a fine 4-inch equatorial belonging to the latter.

It was also observed by Mr. G. H. Clay, of Kingston, Herefordshire, as being remarkably brilliant.

Mr. Gledhill has since sent us the following account of the Aurora of October the 14th and 15th:—At 7 P.M. on the 14th unusual brightness was noticed in the N.W. The sky was cloudless, but rather hazy; the air was calm. At 9 P.M. the finest display of this phenomenon I ever witnessed was seen here. Dense masses and sheets of fiery cloud arched the northern sky from W. to E., being brightest in the W., N.W., and N., and faint in the

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N.E. and E. The horizon was dull, and out of this region bright streamers shot upwards towards the zenith, reaching an altitude of 60°. The broad red arc was some 20° in breadth. So deep was the colour that people gathered at the ends of the streets asking what it was, and where the fire would probably be. Now the colour deepened, and then again it faded to a soft rose. This lasted until after 9.30. The W. and N.W. seemed, as usual, to be the most active region. The bright beams were neither numerous nor brilliant. All had vanished at 10 P.M. except the soft light near the horizon. From this time until 1 A.M. on the 15th nothing but a few faint beams were seen. At 1.30 A.M. thin white low clouds began to fly rapidly across the zenith, from the W. At 2 A.M. the magnificent scene of 9 P.M. was repeated. The lower edge of the fiery arc extended downwards to α Lyræ, sweeping from the W. horizon, through α Cygni, on to Cassiopeia and Polaris, down to the East.

This display of Aurora was also observed by Mr. H. Cox, of West Chase, Maldon, Essex, who states that the most brilliant part was between Vega and Capella.

We may notice that a writer in the *Standard* has asserted that these displays of Aurora are invariably the forerunner of most terrific gales and sweeping storms of wind and rain. This is stated by Mr. William Parish, Master of the Trinity Cutter No. 4, at Dover, not to be always the case; and he gives the instance of Oct. 5 and 6, 1869, when the northern lights were very bright, and the weather continued fine until the 16th, when four days of stormy weather ensued. In the present case, the Auroras of September and October may possibly have been the forerunners of the very severe storms of wind and rain which, for more than a week (from about October 10 to 20), have prevailed both on the coast and inland.

THE CINCINNATI OBSERVATORY.—M. Cleveland Abbe has forwarded to us the Annual Report for 1870 of this establishment. The Equatorial is the principal instrument used at present. As in the case of many other establishments, a want of funds prevents the proper development of this observatory; but the energy of the director seems likely to bring about a remedy for this difficulty. We trust the next report will shew that these exertions are appreciated, by the observatory being placed on a better footing.

THE HACKNEY SCIENTIFIC ASSOCIATION commenced its fourth session on the 25th of October, under the presidency of Charles Reed, Esq., M.P. Mr. Lynn, of the Greenwich Observatory, gave the opening address. The papers proposed to be read at the evening meetings during the session are of much interest, many of them bearing particularly on astronomy.

CALCULATION OF ECLIPSES. — Perhaps Mr. Penrose's work (*Ast. Register*, vol. 7, p. 181) would answer the purpose of "Curiosus." I have always used Loomis' *Practical Astronomy*; but very likely the work is simplified by Mr. Penrose, whose book, however, I have not yet seen. —G. J. W.

CHEAP OBJECT-GLASSES.—Unless any one else can better advise "A Beginner," I should dissuade him from endeavouring to make his own telescope. His plan would be to advertise for a second-hand instrument in the *Register*, or elsewhere, and get a competent friend to examine it before he concludes the purchase.—G. J. W.

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CORRESPONDENCE.

N.B.—We do not hold ourselves answerable for any opinions expressed by our correspondents.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

MAXIMA OF SOLAR SPOTS.

Sir—There is confessedly a difficulty in fixing the exact dates of the maxima and minima of the solar spots previous to the observations of Schwabe, and I therefore hope to be excused if I venture to doubt that Mr. Elvins (p. 223) has disposed entirely of the *possibility* of a connection between extensive action in the photosphere of the Sun and the state of Jupiter in 1790. My authority for Wolf's data was *Celestial Objects* (p. 29, note), where the Rev. T. W. Webb says, "Wolf has suspected an additional longer period of 56 years: maximum, 1836." There is a strange discrepancy between this and the table copied by Mr. Elvins. If the former is correct, 1780 was near a maximum. But the latter has 1785·5 a maximum and 1784·8 and 1798·5 minima—one being 8½ *months* before and the other 13 *years* after that date! I have no present means of verifying either account, and must leave the question for further elucidation.

I am, Sir, yours very truly,

Oct. 11, 1870. T. H. BUFFHAM.

METEORS SEEN IN THE DAY-TIME.

Sir—Mr. Grover, like many before him, myself included, has been entirely mistaken in the appearances described in his letter as meteors seen in the day-time. They are simply snow-flakes in the higher regions of the atmosphere, and nothing else. I have repeatedly seen them close to the Sun, and it is only in this position that the illumination is sufficiently strong to render them visible. If this were not the case, they should be visible indifferently at the same time in other parts of the sky; but you look in vain for them elsewhere than close to the Sun, a position of all others where true meteors would be rendered invisible by its overpowering rays. The late Mr. Dawes and others pronounced these objects seeds of certain plants, which had been drifted high up in the atmosphere; I feel, however, confident that in all cases they are, as suggested by Mr. A. Herschel, simply snow. With my reflector I see them very commonly during the summer, and even in the hottest weather. That they are very high in the atmosphere is evident, for little or no alteration of focus is necessary between them and the celestial bodies. The small velocity with which they traverse the field of view sufficiently proves their atmospheric character. Those who are much accustomed to use the telescope at night will have seen telescopic meteors shoot across the field—which they do momentarily. The so-called daylight meteors sail across the field like feathers in the wind. The two appearances are entirely different. The day meteors have generally been seen by Mercury-hunters, who, looking for their game close about the solar beams, find themselves, strange to say, not unfrequently in the midst of a snow-storm.

I am, Sir, yours &c.,

Birmingham: Oct. 1, 1870. F. BIRD.

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THE MELBOURNE REFLECTOR.

Sir—I am sorry to find that there is a difference of opinion as to the great Melbourne reflector, some of those who have used it even going so far as to pronounce it a failure.

With regard to one point, namely, the possible existence of cavities in the speculum, causing unequal expansion, I can only regret that the mirror was not made of glass. Any cavities could then be seen, and their existence or non-existence would not be a matter of conjecture. Doubtless the question of glass versus metal was fully discussed by the gentlemen to whom its construction was entrusted, but I should like to know the reasons which influenced their decision in favour of metal, as this almost seems a step backwards.

I remain, dear Sir, faithfully yours,

High Street, Godalming: A. WOOLSEY BLACKLOCK.

Oct. 12.

THE ASTRONOMICAL CLOCK OF STRASBURG.

Sir—The reference to this celebrated clock in the *Register* for the present month being slightly inaccurate, it may appear to you worthy of space to insert the following perhaps more authentic notice of it.

There have been three separate clocks in the cathedral; the first, completed in 1354, was placed in the double transept, opposite to the place of the present clock, and its brackets are still left in the wall. It indicated the time, positions of Sun and Moon, a calendar with the principal feasts, and gave motion to several automata, besides a small set of chimes. It was made under the direction of John, Bishop of Lichtenberg, but the name of the maker appears to be lost to history.

A second clock was commenced in 1547, under a most auspicious union of some of the best mathematicians of the time, and the most intelligent workmen procurable. It was progressing favourably when untoward events totally suspended the works until 1570, when it was resumed by Dasypodius, the successor of Herlin, professor of mathematics, and one of the original designers. Dasypodius associated with himself some distinguished mathematicians, an astronomer (Volkenstein, of Breslau), and the two brothers Habrecht, clockmakers, of Schaffhausen. The clock was restored in 1669, and again in 1732, on both occasions by descendants of the original makers, and ceased to act in 1789. It was on a far grander scale than the first, and moved a celestial globe with 1,020 stars (Ptolemy's), a calendar with the moveable feasts, and a large number of automata, which seem to have been very actively employed.

The third and present clock was completed in 1842, and is indeed an astonishing monument of design, skill, and patience. It is exceedingly complicated, and its indications would require much space even to enumerate, as their number is greatly in excess of that of its predecessors. It was designed and made by Schwilque, clockmaker, of Strasburg, whose son has written a most interesting and lengthy essay upon the subject, in the journal of the British Horological Institute, from which I have extracted the above.

Yours truly,

October 1870. HENRY PRATT.

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THE LUNAR CRATER LINNÉ.

Sir—In the short report of my paper (No. 94, p. 214) read before Section A of the British Association, I am made to say that "most observers are agreed that if some of the early pictures of the top of this lunar mountain are accurate, a change must have taken place." As I am responsible only for what I did say, and as I am not aware that *most* observers are agreed upon the point in question, I shall feel obliged if you will kindly favour me with space for the following extract from the identical copy of the paper which I read at Liverpool:—

"It is to Schmidt that we are indebted for one of the most important announcements bearing on the subject of lunar activity, that of a change in the crater *Linné*, 'which,' says Madler (Report Brit. Assoc. 1868, p. 517), 'has hitherto offered the only authentic example of an admitted change.' He had previously said (same report)—'what has lately been observed in the crater *Linné* proves, at all events, that *there* real changes have taken place, and *that* too under circumstances even visible to us.' Further on, however, the great selenographer remarks that, on the 10th of May 1867, his eye having undergone an operation for cataract, he attempted an observation of *Linné* in the heliometer of the observatory at Bonn, and found it shaped exactly and with the same throw of shadow as he remembered to have seen it in 1831. 'The event,' he says, 'of whatever nature it might have been, must have passed away without leaving any trace observable by me.' The doubt still hanging over this object is well known, and it may be regarded as furnishing at least one of the instances of the present state of activity. The uncertainty attaching to the question of change in this particular instance mainly arises from the difficulty of deciding upon the accuracy or otherwise of the delineations of Lohrmann and Beer and Madler, although both describe it as showing a diameter of 5 or 6 English miles. Generally speaking, the observations between 1866 (October) and 1870 (July), all agree in its present appearance differing greatly from that which it must have presented, according to the delineations and descriptions of the two selenographers just named; also that no change of a physical character has taken place in it during the $3\frac{3}{4}$ years it has been under constant observation."

W. R. BIRT.

Observatory, Cynthia Villa, Walthamstow:
Oct. 7, 1870.

CATALOGUE OF BINARY STARS.

Sir—I shall feel obliged if you will allow the following to appear in the next number of the *Register*.

The list of Binary Stars which was presented to the subscribers with the *Astronomical Register* for April 1867 being out of print, and many applications having been made to me for copies, which I have been unable to supply, it has occurred to me that it might be desirable to reprint the catalogue.

As about 600 copies have been distributed (500 by the *Register* and 100 by myself) it is necessary that it be known beforehand whether as many copies are now required as would pay for the cost of printing. I am willing to undertake the preparation of a second edition, but to secure myself from loss, I shall be glad to receive the names of subscribers; and if sufficient copies are ordered by the end of the present year, the work shall be proceeded with, and may be ready for delivery in about three months.

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I propose to carefully revise the present work; to extend it as far as it is capable of extension; to reduce all the epochs to 1880, and to give, as far as practicable, all measures taken since 1857 with which I may be favoured.

In addition to the present catalogue I propose to give diagrams of all the objects, showing the angles of position and distances.

The cost to subscribers will not, I think, exceed 2*s.* 6*d.* per copy, but this will depend, of course, on the number of copies required.

I shall be glad if subscribers will send their names to me as soon as possible, as it is only at this season of the year that I have leisure for such work.

Yours obediently,
A. BROTHERS, F.R.A.S.

Falshaw, Wilmslow, near Manchester:
Oct. 19, 1870.

THE GREAT MELBOURNE TELESCOPE.

(*Continued from our last.*)

Official Report on the Telescope.

The sixth report of the Board of Visitors to the Melbourne Observatory, which was laid before Parliament, refers at length to the telescope. Their opinions may be gathered from the following extracts:—As a piece of mechanism, the telescope, as a whole, is superb. The facility, quickness, and accuracy with which it can be directed to any point by one man is almost marvellous, especially when the enormous weight of the moving mass is considered. Not less worthy of admiration is the precision with which the clock movement causes the telescope to follow the star. In these points it is difficult to conceive how the instrument could have been better. As regards the optical performance of the telescope, the Board is under the disadvantage of not being able to compare it with the performances of other large reflecting telescopes. The members of the Board who examined it can only, therefore, report precisely what they saw. When directed to a star, the definition of the telescope is not satisfactory. The best form to which the image can be brought by any adjustment of the focussing apparatus was an imperfect cross, somewhat resembling the ace of clubs. When out of focus in one direction, the section of the pencil was an approximately circular ring with a dark centre, in which, however, the dark centre was much larger in proportion to the ring than would correspond to the portion of the pencil intercepted by the small mirror; as the image was brought more nearly into focus, the ring became smaller, and the deformation from the circular form became more obvious; at last it assumed the form of an elongated oval, which rapidly passed into one elongated in a direction at right-angles to the former. The best section that could be obtained was just at the transition, when the appearance was cruciform. In the report of the committee of the Royal Society of London, it is stated:—"The committee found that the light of even large stars was collected into small, hard, and perfectly circular discs free from rays." This clause of the committee's report presented great difficulty to the members of the Board who examined the telescope; and notwithstanding the fact that Mr. Le Sueur stated in his report with reference to the testing in Dublin, that to his eyes, "with no combination of mirrors, and on no day or night were stars defined in a

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manner at all approaching to that described in the committee's report," they felt it to be incredible that gentlemen of the high scientific position of the members of the committee could have seen what the members of the Board saw, and written as they did. This difficulty, however, seems to be removed by the fact that speculum B—the one now in use—was repolished after the examination by the committee. This is clear, from the following passage in a letter from Dr. Robinson to Mr. De la Rue:—"Speculum B was repolished to remove a slight diffusion of light which you noticed, and which was perfectly removed by the process. *His command of figure is so great that I am certain this speculum also was perfect when it left his hands.*" From the words in italics it appears that the committee never tested this speculum in its final state, and that it was sent out entirely in reliance on Mr. Grubb's well-known command of figure. This circumstance entirely relieves the members of the Board from the unpleasant position of differing from the members of the committee on so simple a matter of fact. While reporting thus fully on the performance of the telescope when directed to a star, the Board desires to remind your Excellency that the observation of stars is not the purpose for which the telescope was constructed. "Its primary object," as stated in the last report, "is the examination of the nebulæ of the southern hemisphere." When directed to these objects, the performance of the telescope appears to the members of the Board to be admirable. For the purpose of testing this definitely, the telescope was directed in succession to a considerable number of the nebulæ figured in Sir John Herschel's volume of Cape observations, and the appearance of the nebulæ, as seen in this telescope, compared with those drawings. The amount of detail shown in the telescope was so great, and the consequent alteration of the general appearance so striking, that in some instances it was difficult to identify the objects. It is, of course, impossible to say how far the engraver of the figures in Sir John Herschel's book has succeeded in representing accurately the appearances in his telescope; but the plates present every indication of being executed with great care; and, assuming that they represent as nearly as may be what Sir John Herschel saw, there can be no doubt that the superiority of the Melbourne telescope over his is as great as was to be expected from its greater dimensions, and from the greater experience in the construction of such instruments. For this, then, which is its proper work, the telescope, in the opinion of the Board, is admirably suited.

The Defect and the Remedy.

From "The Melbourne Leader," June 18.

Much light has been thrown on the great Melbourne telescope. By comparing Mr. Severn's criticisms on it with the report of the Board of Visitors and the annual report of the Government astronomer, the mystery which previously surrounded the instrument has deen dispelled. There is a general agreement between all the witnesses as to the instrument's badness of definition. When at its best it makes a star look like the ace of clubs. If an attempt be made to remedy this defect by altering the focus, a more circular figure is obtained, but it has a dark centre. It represents the stars to be illuminated cart-wheels. Of course there are neither aces of clubs nor cart-wheels among the stars, and the telescope which reveals such figures represents things that are not. The counsel for the defence say that the telescope is not intended for star-work. It is a space-penetrator for reveal-

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ing faint nebulæ. But the instrument that distorts one object will distort another, and it is surely useless to attempt to figure the nebulæ with an instrument which merely gives a choice of distortions. In its present state the instrument is worse than useless. It makes misrepresentations, and cannot reveal the truth even by accident. The cause of this state of things, however, is known, and can of course be rectified. There are two large specula, and neither of them is fit for use. One is discoloured and tarnished, the other is out of shape. There can be no work done satisfactorily with the telescope until at least one speculum has been refigured and repolished. It is satisfactory to learn that the Government astronomer is impressed with the necessity for a better speculum, and that his preparations for repolishing are nearly completed. The operation is a difficult one, and failure may await the first trials; but by perseverance a steady approach towards perfection will be made.

A good deal of recrimination has been going on between Mr. Grubb, the maker of the instrument, and our local astronomers. The reason why the telescope has not performed so well in the colony as it did in Ireland is not clearly shown, but it is supposed that the speculum used there was repolished, with the view of remedying some small defect, and that in the operation it was spoilt. There is reason to suppose that this is the true explanation; and if so there is room for hope that the telescope will yet prove to be an excellent one. If the attempt at repolishing should lead to no satisfactory result, it may become advisable to try a speculum of silvered glass, the advantage of which is that if once obtained of true shape, there would be no risk of subsequent distortion. The London committee recommended metal specula, because no glass one of so large a size had ever been made. But the difficulty is not an insurmountable one, and the advantages would be permanent. The whole telescope is an experiment, and it has so many excellences that no chance of curing its defects should be left untried.

Mr. Severn has called attention to what he believes to be a serious error, which has arisen from the defective state of the telescope. Mr. Le Sueur announced some months ago that the nebula surrounding the star *eta* in Argo was not of the shape which is described by Herschel; that the star which had formerly been in the densest part of the nebula was no longer surrounded by nebulous matter. This discovery has been made known far and wide in Europe, and theories have been built on the phenomenon. Mr. Severn now gives reasons for believing that the centre of the nebula is invisible from the tendency which the telescope has to make a cart-wheel of every brilliant object. This is a serious matter, for it is not the first alleged scientific discovery which has been claimed for the colony, without any just title thereto. Mr. Severn quotes the last edition of Herschel's Astronomy, to show that a similar error was fallen into by Mr. Powell, of Madras, who announced the disappearance of the nebula, but was soon afterwards convinced of his error by Lieut. Herschel, who took great pains to verify the correctness of the observations taken by Sir John Herschel at the Cape of Good Hope. This coincidence of error, if error it be, is very alarming. But it cannot be said that the evidence on one side or the other is at all clear. The witnesses are paired off two and two. Mr. Le Sueur has not yet answered the implied charge, but we shall, no doubt, have a defence of his position at the next meeting of the Society.

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CHANGES IN OUR ASTRAL HEAVENS.

It is proposed to give a few illustrations of these, as arising—(1) from precession; and (2) from proper motions. 1. As to precession. Careful measurements from a celestial globe would generally furnish us with results fairly accurate: most of the following, however, are derived from a little calculation; but as approximations only were in view, account was not taken, except in a few cases, either of the variation in the obliquity of the ecliptic, or of the proper motions of the stars.

EQUINOCTIAL POINTS.—The *vernal equinoctial point* entered Taurus (the constellation)	about	B.C. 4,500
It left Taurus and entered Aries	„	B.C. 1,700
Left Aries and entered Pisces	„	B.C. 100
Will leave Pisces and enter Aquarius	„	A.D. 2,800
Autumnal equinoctial point entered Scorpio (the constellation)	„	B.C. 3,900
Left Scorpio and entered Libra	„	B.C. 2,400
Left Libra and entered Virgo	„	B.C. 800
Will leave Virgo and enter Leo	„	A.D. 2,400
SOLSTITIAL POINTS.—The *summer solstitial point* entered Leo (the constellation)	„	B.C. 4,100
Left Leo and entered Cancer	„	B.C. 1,500
Left Cancer and entered Gemini	„	Nativity.
Will leave Gemini and enter Taurus	„	A.D. 2,000
The *winter solstitial point* entered Aquarius	„	B.C. 3,700
Left Aquarius and entered Capricorn	„	B.C. 2,100
Left Capricorn and entered Sagittarius	„	B.C. 200
Will leave Sagittarius and enter Scorpio	„	A.D. 2,600
COLURES.—The *equinoctial colure* passed through Aldebaran and Antares	„	B.C. 3,000
Through the Pleiades	„	B.C. 2,300
Through Spica Virginis	„	A.D. 300
The *solstitial colure* passed through β Leonis (Deneb)	„	B.C. 3,900
Through Regulus	„	B.C. 2,300
Præsepe in Cancer	„	B.C. 700
Between Castor and Pollux	„	A.D. 400

Effect of precession in changing the Pole Stars.—Only those stars are here noticed which are at least of the third magnitude, and not more than five degrees from the Pole at its nearest approach to them.

Dates of the nearest approach of the Pole to the following stars, and its (approximate) least distance from them:—

ι Draconis (*al-dhibá*, the hyæna), B.C. 4,800; distance, $4\frac{1}{2}°$.
(Era of the Creation, according to the chronology of R. S. Poole, B.C. 5,421).

α Draconis (*al-thúbán*, the dragon), B.C. 2,800; distance $\frac{1}{4}°$.
(Era of the Flood, according to R. S. Poole, B.C. 3,159).

κ Draconis, B.C. 1,300; distance, $4\frac{3}{4}°$.
(Era of the Exodus, according to R. S. Poole, B.C. 1,652.)

α Ursæ Minoris, A.D. 2,100; distance, $\frac{1}{2}°$.

γ Cephei, A.D. 4,200; distance, 2°.

α Cephei (*al-ráí*, the shepherd), A.D. 7,500; distance, $2\frac{1}{2}°$.

δ Cygni . . . . A.D. 11,600; distance, 2°.

α Lyræ (Wega, for *Wákí*, part of the compound name *al-nesr-al-Wákí*, the falling eagle), A.D. 13,800; distance, $4\frac{3}{4}°$.

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After this, for 7,200 years, there will be no conspicuous pole star till ι Draconis again takes that place.

To us, as a maritime nation, the present most convenient polar star has been of the greatest utility. Admiral Smyth calls it "the most practically useful star in the heavens, whether to the astronomer or the seaman;" and observes that "the want of such a constant reference at the opposite pole is severely felt."

Effect of precession on the visibility of certain stars, and the altitude of others.—It is gradually withdrawing some and bringing others into view. Remembering that the circle of perpetual occultation for London is in $38\frac{1}{2}°$ S. declin., a consideration of the celestial globe makes it evident that no stars of greater S. latitude than $38\frac{1}{2}° + 23\frac{1}{2} = 62°$ can appear above the horizon there, supposing the obliquity of the ecliptic constant; and whilst it is decreasing, this latitude would be lessened by the amount of that decrease. Also, $38\frac{1}{2}° - 23\frac{1}{2} = 15°$; and no star of less S. latitude than this can become invisible at London, supposing the obliquity of the ecliptic constant; and whilst it is decreasing, this latitude would be increased by the amount of that decrease. Thus, the decrease of the obliquity of the ecliptic has the effect of preventing some stars ever appearing above the horizon which otherwise would appear, and of preventing others disappearing below it which otherwise would disappear. But the effect of refraction has to be considered also. Stars from 90° to 270° of longitude are descending, and those from 270° to 90° of longitude are ascending in the heavens.

Sirius.—Estimate by globe. Sirius began to be visible at Greenwich when its longitude was 353° +. It then increased in altitude till its longitude was 90°, and then began to descend in the heavens, and will continue to do so till its longitude is 185° +, when it will become invisible. It will still increase in S. declination till it attains long. 270°, when its declination will be about 63° S.; after which it will begin to go northwards again.

By computation, we find that Sirius was at its least S. declination, 16°, about 900 years ago, taking the obliquity of the ecliptic at that time as 23° 35′. Its meridian altitude then began to decrease; and, after 6,200 years from the present time, having a south declination of above $38\frac{1}{2}°$, it would no longer appear above the horizon of London; but that refraction will delay its disappearance for a whole century. It will reach its greatest S. declination, 63°, in upwards of 12,000 years hence.

Procyon; long. 114°, lat. 16° 0′ S. This star is also getting lower down in the heavens of London. It will cross the equator in long. 138° 40′ in about 1,800 years hence. It will become invisible for a comparatively short time in about 11,500 years.

α Orionis (Betelgeuze, from *ibt-al-jauzá*, "the shoulder of the Jauza"); long. 86° 56′, lat. 16° 2′ S. This star is rising in the heavens, and 300 years hence it will be at its highest. When its longitude is 255°, its declination will be rather more than $38\frac{1}{2}°$ S., so that in 12,000 years' time it will not for an interval rise at London. This involves, of course, the temporary disappearance of the whole constellation of Orion, except the head, from our heavens.

δ Orionis; long. 80° 33′, lat. 23° 33′ S. Mintaka ("the belt"), with a declination at present of only 24′ S., and which will continue to rise for nearly 700 years to come, seems at first certain to cross the equator. This, however, it can never do: at the end of that period it will still have more than 6′ S. declination, and then begin to recede south again. In fact, it will not get so near the equator as that, if we take into consideration the 6′ by which the obliquity of the ecliptic will have decreased in 700 years, and which will make its declination 12′ S. at its nearest approach. It is

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evident that no star whose latitude (N. or S.) exceeds the obliquity of the ecliptic can reach the equator.

REGULUS will cross the equator from N. to S., in long. 181° 4½′, in 2,400 years hence. Although its latitude is nearly ½° N., and it can therefore never disappear from our sky, yet precession after a very long period will allow of its meridian altitude being no more than

Decl. of circle of perpetual occult. − obliquity of eclipt. + star's latit. or 38° 31′ − 23° 27′ + 0° 28′ = 15° 32′, or about 3° above that of Antares now.

α AQUARII; long. 331° 31′, lat. 10° 42′ N. *Sa'd-al-melik* (the King's lucky star) will cross the equator from S. to N., in long. 334° 10′, in less than 200 years hence. It will finally attain a meridian altitude of 38° 31′ + 23° 27′ + 10° 42′ = 72° 40′; about 2° above that of Castor now.

α VIRGINIS. Spica crossed the equator from N. to S. in long. 175° 18′. This was 1,900 years ago. It is descending in the heavens, and at its lowest will have a meridian altitude of 13°. Its *greatest* possible meridian altitude at London is 60° (13° + twice obliq. eclipt.).

o CETI. Mira became visible in the latitude of London, in long. 285°, 7,500 years ago. It is rising in the heavens, and at its highest will attain a meridian altitude of 46°; a little less S. latitude would have prevented this star and Procyon ever disappearing at London.

(*To be continued.*)

EXTRACTS FROM "THE EARTH."

[A Popular Lecture, by Professor G. B. DONATI. *April* 1870.]

After observing that while things are laid to the account of the Moon with which it has nothing to do, the Professor expressed an opinion that the Moon, together with fire and water, has had a great influence in bringing the earth into its present condition, owing to its tidal action in remote times having been far greater than at present. Laplace proved that this action is unchangeable when the depth of the seas is very small in comparison with the earth's radius, and when at the same time the mean density of the globe is greater than that of water. Now the mean depth of the seas is less than the 1000th part of the earth's radius,* and the density of the earth is about five and a half times that of water. "But might not the earth have formerly been in such a condition as to allow of the tides producing results very different to the present? . . . The originally fluid and incandescent mass of the globe, gradually cooling, must have been surrounded by a most extensive atmosphere, loaded with aqueous vapour, which must have been condensed and precipitated upon the surface of the mass, which from the decrease of fire and increase of water must have undergone enormous changes, whenever (as is very probable) its cooling was not everywhere regular and uniform. But besides this, how very different, and how much greater than now must have been the tidal action! . . . The whole mass of the earth in a fluid state must have obeyed that force which our satellite at present exercises only on the seas.

Let us next imagine that in that fluid mass there began to be formed, by

* Waves are propagated with greater velocity in deep waters, and less in shallow. On the basis of this fact, it has been possible to measure the mean depth of seas, which has resulted in 4800 metres for the Atlantic, and 6400 metres for the Pacific.

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reason of its cooling, a thin solid crust. This would be sufficient to oppose at once the lunar action, but not so much so as to prevent its making the water already formed by the condensation of vapours to run along the said crust; many parts of which may also have remained alternately either flooded or dry. Moreover, the possibility or rather probability will be conceived that things may have been arranged in a manner to render possible even for a very long time a certain general equilibrium of the different portions of the terrestrial mass; and that the continuous action of the moon may have very gradually raised large areas, either not well solidified, or not well cohering together; rendering them inclined to the horizon, whereas before they were in a perfectly level state.

By this, and the progressive condensation of elastic vapours, there must have arisen continually new and most potent forces, which sooner or later must have ended by destroying the equilibrium temporarily established. That once destroyed, the interior and still fluid parts of the mass must have mounted above the solid crust, and formed as it were seas, the depth of which must have been very far from being comparatively very small in relation to the dimensions of the whole mass, and which would not either have been of a density less than the mass itself, and in consequence the tidal action must have rendered unstable the equilibrium between the fluid and the already solidified parts of the earth. The changes and dislocations may also very well have been such and so great as even to change the direction of the axis on which the earth turned at the beginning; and such a change of the axis in its turn must have produced fresh and stupendous revolutions. They may have either occurred suddenly and by starts, or else ordinarily in a continuous and progressive manner, and merely accompanied by sudden cataclysms, which may be considered, however great, as partial and local in respect of the dimensions of the whole earth.

Moreover, it may evidently have happened that some of the already solidified portions of the mass may have floated upon the still fluid mass, and that, cast here and there, they may have originated the mountains of our globe, in proportion as it went on becoming solid. Our actual polar seas, which are composed of plains and mountains solidified together by a very low temperature, perhaps offer us a very faint image of what may have happened when all the terrestrial surface from being fluid became solid.

Observing that such phenomena cannot recur in the present condition of the earth, and noticing other causes besides the tides which gradually change its surface, as rivers, volcanos, earthquakes, the Professor proceeded:—"I have already said that the waters of the sea are accumulated in that part of our globe which is turned towards the moon, and on the opposite side. But the earth by its rotation tends to carry with it these liquid prominences, and remove them from their normal position; thus they gradually disappear, to be again formed in the direction of the moon; then again they are transported from that direction, and so on continually. This perpetual displacing of the waters of the seas, which are always endeavouring to attain a position of equilibrium which they can never reach, cannot be effected without there arising amongst the different parts of the globe friction and attrition, the consequence of which is necessarily to retard the movement of rotation of the earth on its axis. M. Delaunay, who discovered this result of the tides, calculates that by means of it the days may be lengthened in the course of a thousand centuries one second. The alteration is indeed very small; nevertheless it is become already manifest with certainty in some astronomical phenomena; and from small it will become great in the progress of time, which is infinite. It is not worth while to stop to discuss the changes which must take place in all the life which is developed

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on our globe when its days shall be longer than the present, since every one must perceive that these changes must be very great, but no one can foresee what they will be." . . . M. Donati observed that as we are ignorant of the true nature of gravitation, so neither can we know if it will ever remain constant, or whether it be possible that it should diminish, or cease. He adverted next to the effect of the ether with which space is filled, to bring about, after an immense interval, the destruction of the solar system, the earth included; and he concluded his lecture by remarking:—"All about which I have hitherto been discoursing appears to me enough to demonstrate the possibility, nay, the probability of the action of certain general causes on the conformation of the earth. It would be impossible for me at present to descend to more minute particulars. I have but one statement to make in the last place, and that is, when I have spoken of the *ruin*, of the *end*, of the *destruction* of things past, present, and future, I have done so merely from the exigency of language; since nothing really goes to ruin, or ends, or is destroyed, but rather everything is transformed, and every force is preserved, in the eternity and *circularity* of nature."

Astronomical Heresies.—Mr. T. F. Jackson, of Godalming, has forwarded to us several papers and illustrations of his ideas as to the movements of the heavenly bodies. He considers that "the world is a globe divided into three parts by the equator and the earth: the earth is the ballast of the globe, and the waters are the oscillating pendulum of self-adjusting power." "The moon is the mirror of the creation; in her face are the features of the earth: it is about 610 miles in diameter." "The diameter of the sun is 784 miles; it represents a ring of blazing fire, and is the consumer of the gaseous fluids that rise from the earth. The interior of the ring is a projecting body, with a collapsing and expanding motion like the playing of a concertina." Mr. Jackson rejects Newton and all his works, and is prepared to put any gentleman in possession of means which will enable him to attest the validity of his observations in six months. We feel obliged to Mr. Jackson for the pretty pictures he has sent us; they must have cost him both thought and money—which we fear will be thrown away upon the incredulous astronomical public.

The late Mr. Edmund Salter.—By the death of this gentleman, who was the victim of a melancholy accident at the Peterborough Railway Station, astronomy has lost a zealous follower. He had the advantage, though short-sighted, of excellent vision for minute objects, and is said to have seen nine stars in the *Trapezium* with a 12-inch mirror. He was an Inspector of Schools under the British and Foreign School Society, his duties leading him to visit many places in the kingdom, and wherever an accessible astronomer was to be found, he seldom failed to make his acquaintance.

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D'ARREST'S COMET.

Communicated by G. F. Chambers, Esq.

Ephemeris for November.

Berlin Mean Moon.

1870.		R.A. h.	m.	s.		N.P.D. °	′
Nov. 1	...	20	34	3	...	117	46
3	...	20	42	32	...	117	42
5	...	20	50	56	...	117	36
7	...	20	59	14	...	117	27
9	...	21	7	26	...	117	16
11	...	21	15	32	...	117	3
13	...	21	23	30	...	116	49
15	...	21	31	21	...	116	32
17	...	21	35	14	...	116	23
19	...	21	46	44	...	116	53
21	...	21	54	10	...	115	32
23	...	22	1	30	...	115	9
25	...	22	8	43	...	114	44
27	...	22	15	48	...	114	19
29	...	22	22	45	...	113	52

The comet has passed its theoretical maximum brightness without having been picked up by any observer: it is likely, therefore, that it will altogether escape notice at the present return to perihelion.

ELEMENTS OF COMET II. OF 1870.

Epoch of Perihelion passage	=	Sept 2·385	
		°	′
Longitude of Perihelion	=	7	58
Longitude of Ascending Node	=	12	56
Inclination of Orbit	=	99	21
Log. Perihelion Distance	=	0·259390	

Calculator:—J. Palisa, of Vienna.

Ephemeris.

For Berlin Mean Noon.

1870. Nov.		R. A. h.	m.	s.		Decl. °	′		Log. Dist. from Sun.
2	...	21	33	31	...	+ 29	4·3	...	
4	...	21	29	8	...	28	54·5	...	0·15831
6	...	21	25	11	...	28	45·1	...	
8	...	21	21	39	...	28	36·3	...	0·18431
10	...	21	18	29	...	28	28·1	...	
12	...	21	15	40	...	28	20·7	...	0·20915
14	...	21	13	11	...	28	14·1	...	
16	...	21	10	58	...	28	8·3	...	0·23277
18	...	21	9	2	...	28	3·3	...	
20	...	21	7	21	...	27	59·0	...	0·25514
22	...	21	5	53	...	27	56·0	...	
24	...	21	4	38	...	27	53·7	...	0·27629

P.S.—D'Arrest's comet has at last been found. It was discovered by Winnecke, at Karlsruhe, on August 31, but some days elapsed ere he could satisfy himself that he was observing a comet and not a nebula. He noted it to be exceedingly faint.

Oct. 18, 1870. G. F. CHAMBERS.

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ASTRONOMICAL OCCURRENCES FOR NOV. 1870.

DATE		Principal Occurrences		Jupiter's Satellites		Meridian Passage
		h. m.			h. m. s.	h. m.
Tues	1		Sidereal Time at Mean Noon, 14 42 17·1	1st Sh. I. „ Tr. I. 3rd Sh. I. 1st Sh. E. „ Tr. E. 3rd Sh. E.	13 41 14 38 15 20 15 55 16 53 17 50	Moon — 7 17·3
Wed	2			1st Ec. D. „ Oc. R. 2nd Ec. D.	10 51 21 14 0 18 45 37	8 3·9
Thur	3		Saturn's Ring: Major Axis = 34″·9 Minor Axis = 15″·8	1st Sh. I. „ Tr. I. „ Sh. E. „ Tr. E.	8 9 9 5 10 24 11 19	8 47·9
Fri	4			1st Oc. R. 2nd Sh. I. „ Tr. I. „ Sh. E. „ Tr. E.	8 27 12 55 14 44 15 31 17 21	9 30·2
Sat	5			3rd Ec. R. „ Ec. D. „ Oc. R.	7 37 10 8 50 11 18	10 11·7
Sun	6		Meridian Passage of the Sun, 16m. 14s. before Mean Noon	2nd Ec. D. „ Oc. R.	8 3 18 12 23	10 53·0
Mon	7	19 32	○ Full Moon	1st Ec. D.	18 16 39	11 35·1
Tues	8			2nd Tr. E. 1st Sh. I. „ Tr. I. „ Sh. E. „ Tr. E.	6 30 15 34 16 24 17 49 18 39	12 18·4
Wed	9	10 3 11 26 12 11	Near approach of Moon to δ^1 Tauri (4) Occultation of δ^3 Tauri (5) Reappearance of ditto	1st Ec. D. „ Oc. R.	12 45 10 15 46	Neptune — 9 59·9
Thur	10			1st Sh. I. „ Tr. I. „ Sh. E. „ Tr. E.	10 3 10 51 12 18 13 5	9 55·9
Fri	11	3 21 8 36	Conjunction of Moon and Jupiter, 0° 51′ N. Conjunction of Venus and Mercury, 0° 17′ S.	1st Ec. D. „ Oc. R. 2nd Sh. I. „ Tr. I. „ Sh. E.	7 13 37 10 12 15 30 17 2 18 6	9 51·9
Sat	12			1st Sh. E. „ Tr. E. 3rd Ec. D. „ Ec. R. „ Oc. D. „ Oc. R.	6 46 7 32 9 17 46 11 37 34 12 16 14 43	9 47·8
Sun	13	17 12 17 39	Conjunction of Moon and Uranus, 0° 52′ S. Near approach of Moon to Uranus	2nd Ec. D. „ Oc. R.	10 39 18 14 42	9 43·8
Mon	14	9 34 9 38	Occultation, reappearance of 39 Cancri (6) Occultation, reappearance of 40 Cancri (6)			9 39·8
Tues	15	20 59	Illuminated portion of disk of Venus = 0·996 of Mars = 0·909 ☾ Moon's Last Quarter	2nd Tr. I. „ Sh. E. „ Tr. E. 1st Sh. I. „ Tr. I.	6 11 7 24 8 47 17 29 18 9	9 35·8

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DATE		Principal Occurrences		Jupiter's Satellites		Meridian Passage
		h. m.			h. m. s.	h. m.
Wed	16		Sidereal Time at Mean Noon, 15 41 25·4	1st Ec. D. „ Oc. R.	14 39 7 17 31	Neptune 9 31·8
Thur	17	1 6	Conjunction of Moon and Mars, 2° 46′ S.	1st Sh. I. „ Tr. I. „ Sh E. „ Tr. E.	11 57 12 36 14 12 14 50	9 27·8
Fri	18			1st Ec. D. „ Oc. R. 2nd Sh. I. „ Tr. I.	9 7 35 11 57 18 5 19 19	9 23·8
Sat	19			1st Sh. I. „ Tr. I. „ Sh. E. „ Tr. E. 3rd Ec. D. „ Oc. R.	6 26 7 2 8 41 9 16 13 17 9 18 5	9 19·8
Sun	20		Meridian passage of the Sun, 14m. 13s. before Mean Noon	1st Oc. R. 2nd Ec. D. „ Oc. R.	6 23 13 15 14 16 59	9 15·7
Mon	21					9 11·7
Tues	22	5 43 6 43 12 8 13 21	Conjunction of Moon and Venus, 3° 9′ S. Superior Conjunction of Mercury Conjunction of Moon and Mercury, 4° 1′ S. ● New Moon	2nd Sh. I. „ Tr. I. „ Sh. E. „ Tr. E. 1st Sh. I.	7 23 8 26 9 59 11 3 19 23	9 7·7
Wed	23			3rd Tr. I. „ Sh. E. „ Tr. E. 1st Ec. D. „ Oc. R.	5 23 5 50 7 50 16 33 12 19 15	9 3·7
Thur	24	2 40 8 25	Conjunction of Mars and χ Leonis, 6m·3 W. Conjunction of Moon and Saturn, 0° 16′ S.	2nd Oc. R. 1st Sh. I. „ Tr. I. „ Sh. E. „ Tr. E.	6 6 13 52 14 20 16 6 16 35	8 59·7
Fri	25			1st Ec. D. „ Oc. R.	11 1 42 13 41	8 55·7
Sat	26			1st Sh. I. „ Tr. I. „ Sh. E. „ Tr. E. 3rd Ec. D.	8 20 8 46 10 35 11 1 17 17 13	8 51·7
Sun	27			1st Ec. D. „ Oc. R. 2nd Ec. D. „ Oc. R.	5 30 17 8 7 15 51 7 19 14	Moon — 4 18·6
Mon	28			1st Sh. E. „ Tr. E.	5 3 5 27	5 11·7
Tues	29	10 33	☽ Moon's First Quarter	2nd Sh. I. „ Tr. I. „ Sh. E. „ Tr. E.	9 58 10 41 12 35 13 18	6 0·7
Wed	30			3rd Sh. I. „ Tr. I. „ Sh. E. „ Tr. E. 1st Ec. D.	7 17 8 39 9 51 11 8 18 27 25	6 46·2
Dec. Thur	1			2nd Ec. D. „ Oc. R. 1st Sh. I. „ Tr. I. „ Sh. E. „ Tr. E.	5 9 14 8 21 15 46 16 4 18 1 18 18	7 29·3

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THE PLANETS FOR NOVEMBER.

At Transit over the Meridian of Greenwich.

Planets	Date	Right Ascension	Declination	Diameter	Meridian Passage
		h. m. s.	° ′		h. m.
Mercury	1st	13 44 50	−9 4½	5″·2	22 58·8
	15th	15 11 37	17 40	4″·8	23 30·3
Venus	1st	13 57 11	−10 41½	9″·8	23 11·1
	15th	15 5 27	16 35½	9″·8	23 24·1
Mars	1st	10 19 46	+12 10	6″·4	19 34·2
	15th	10 48 31	9 33½	6″·9	19 7·9
Jupiter	1st	5 42 16	+22 50	42″·5	14 57·5
	15th	5 37 23	22 48½	43″·9	13 57·6
Neptune	1st	1 16 8	+6 11	—	10 32·1
	17th	1 14 42	6 3	—	9 27·8

Mercury passes the meridian about an hour before noon at the beginning of November, the interval decreasing until the planet comes to superior conjunction on the 22nd, close to the Sun. It is not well situated for observation this month, except just at the commencement, when it may possibly be seen in the mornings.

Venus is getting very near to the Sun. The planet passes the meridian at the beginning of the month, at about 10 minutes past 11 o'clock, and about a quarter of an hour before noon at the end of the month.

Mars passes the meridian about half-past 7 in the morning at the beginning of the month, and about half-past 6 at the end of November. The planet may be seen in the early morning.

Jupiter, from its great northerly declination, is now in splendid view, and is the most important object at the present time. The planet may be observed from about 9 o'clock in the evening until daybreak. It passes the meridian shortly before 1 o'clock in the morning, at the end of the month.

Neptune passes the meridian about half-past 8 in the evening at the end of this month, and is therefore well situated for observation.

ASTRONOMICAL REGISTER—Subscriptions received by the Editor.

To September 1870.
Brothers, A.
Metcalf, Rev. W. R.

To December 1870.
Burlingham, R.
Buffham, T. H.
D'Alquen, F. M.
Green, N. E.
Guyon, G.
Hemming, Rev. B. F.
Jackson-Gwilt, Mrs.
Holden, Rev. W. T.
Lancaster, J. L.
Lancaster, W. L.
Ryle, Rev. J. C.
Woodman, T. C.
Wright, W. H.

To January 1871.
Shaw, Rev. J.

To March 1871.
Mills, E. B.

October 22, 1870. Subscriptions after this date in our next.

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THE OBSERVING ASTRONOMICAL SOCIETY.

Hon. Sec. William F. Denning, Ashley Road, Bristol.

Report of Observations made during the period from July 7 to August 6, 1870, inclusive.

Solar Phenomena.

Mr. Thomas G. E. Elger, of Bedford, reports that—"The sun spots observed during July exceeded in number those recorded in the previous month, but they were, with a few exceptions, small (less than 30″ in diameter), and although pretty equally distributed between the two hemispheres, those to the south of the sun's equator presented a remarkable contrast, both in type and size, to those observed to the north of it; the former, as in June, included some large scattered groups and moderately-sized spots of the normal class, while the latter consisted chiefly of solitary specks without penumbræ, and clusters of minute black punctures, which frequently assumed very grotesque configurations. A striking feature of the large groups, observed during the early part of the month, was an evident tendency either to close up or to become dissociated upon reaching a certain position of the disc—about half-way between the E. limb and the centre. On the 25th, one of the largest groups observed this year appeared at the E. limb. On the 28th it measured nearly 5′ in length, and consisted of a large *preceding* spot, of 1′ 10″ in diameter, followed by a straggling train of "wispy" penumbræ, enclosing several small spots. This group dwindled away very rapidly after the 28th. Another large spot, about 50″ in diameter, was observed from July 13th–25th.

Fresh groups observed in the sun's N. hemisphere during July 9.
" " " " S. " " " 12.
Maximum number of groups on disc—12 (July 13, 5h. 30m.)
Minimum number of groups on disc— 4 (July 28, 5h. 10m.)"

Mr. Albert P. Holden, of London, says:—"I observed a very interesting spot on June 21, at 7 A.M. The penumbra was unusually pale, and the umbra of a decided light *brown* hue. Four darker openings, arranged in a square, were observed in the umbra, and were readily seen with a very small aperture. A very remarkable circumstance in connection with the sun's spots during the last two months has been their extremely light colour. The light brown tints of the umbræ have been very marked, and totally different from the dark hues they usually present, while at times the penumbræ have been so light as to be scarcely visible. In most of them, however, the nucleus (which is ordinarily so difficult to detect) has been very easily seen, as in the case of the foregoing observation. This fact proves the phenomenon seen to be due to the actual lightening of the spots themselves, because, if it were merely an optical or atmospheric effect, the *whole* spot would be lighter, and the nucleus would be quite as difficult to detect as before. It is probable that these appearances may be a necessary result of the maximum of sun-spot activity, and are due (as suggested by Mr. Lockyer) to the thinness of the solar envelope at the present time. This would certainly account for the light hues of the umbræ and penumbræ, and also for the frequency and blackness of the nucleus."

Mr. Henry Ormesher, of Manchester, writes that—"On the 31st July, from 2h. 15m. to 3h. 0m., while looking at the sun with my 3-in. refractor, I saw a beautiful large cluster of spots, occupying an almost central position on the disc. It occurred to me that the umbra in the largest spot appeared more dense on the eastern side. I therefore determined to examine it with

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my 5¼-in. refractor; I did so, using a power of 181. The result was, that it resolved itself into a very fine nucleus, of a somewhat oval shape. After making myself sure that this was the case, I examined the cluster, and was struck with the beautiful appearance of the brighter part of the sun's atmosphere. A very bright stream ran across the cluster in a zigzag direction, separating the penumbra. Some parts of this stream, particularly the upper part, appeared brighter than others, presenting a very mottled appearance."

On July 14, Mr. William F. Denning, of Bristol, examined the sun with his 3-in. O.G., and found that many large maculæ were visible on various parts of the disc. There were nine large spots surrounded with penumbræ. In the N. hemisphere, and about half-way across the disc, an enormous group was perceptible. On July 26, when endeavouring to pick up Mercury, he observed several bright, ill-defined objects pass rapidly through the field of the telescope. He is of opinion that these bodies were nothing more than thistle seeds.

The Eclipse of the Moon on July 12.

The Rev. Ralph Prowde, of Northallerton, reports that—"He observed this phenomenon, but the only thing remarkable was, the great contrast of shade between the darker and lighter penumbræ. I say penumbræ, for I suppose the real umbra of the earth's shadow falls within the moon's orbit. The darker interior cone of shadow obscured the edge of the moon, and the objects on its surface as it passed over them almost entirely, but its own edge did not seem to be nearly so regularly round as the lighter enveloping cone of shade."

The Rev. S. J. Johnson, of Crediton, sends the following:—"I had a very favourable observation of the lunar eclipse on July 12. Sky clear at first, with a small amount of stratus near the horizon. I first caught sight of the moon at 8h. 41m., but it was 8h. 49m. before it got entirely clear of some small clouds. I paid particular attention to the degree of distinctness with which the eclipsed portion could be seen. When about 4 digits were covered, I first noticed the copper colour through the telescope; I fancy this would be a little sooner than in the last eclipse I observed (September 1867); but in that of October 4, 1865, which was only of 4 digits, the copper tint was very decided in the telescope at the time of the greatest obscuration. When about 6 digits or half the disc was covered, the copper colour could be clearly seen with the naked eye. I could not make out any particular parts of the moon's surface till 9h. 35m., when I noticed the *Mare Tranquilitatis* and the *Mare Serenitatis* showed with beautiful distinctness through the earth's shadow in the telescope. A few minutes after the totality was attained, I was struck by the obscurity of the eastern side of the moon being so much greater than I expected. At 9h. 55m. at least half of its surface was as if blotted out, even when seen through the telescope, although I used two different powers, 70 and 150. Three of the *seas* at the W. side were all I could make out. Possibly a thin coating of cirrus cloud, which covered all the sky about this time, might account in some measure for the invisibility of the moon. By 10h. 30m. this had entirely cleared away, and the Milky Way, near the moon, was about as distinct as it usually appears on a dark clear night. At this period the upper portion of the moon was the invisible part; all those regions lying round the margin of the disc being alone to be seen, except at the vertex, where they were imperceptible. At 11h. 23m. the first streak of light was breaking forth at the eastern edge. At 11h. 45m. the red colour was nearly gone; the eclipsed part appeared of a grey colour. At 11h. 58m. I noticed

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there was no trace of the Milky Way, and at 12h. 24m. the lunar circle was again complete."

Mr. Edmund Neison, of London, writes:—"The colour of the eclipsed disc was, during the whole time, a dull yellowish, olive green, both in the telescope and out, but was never dark enough to prevent many of the chief markings and craters being seen. From 10h. 44m., when the lunar disc was fairly above the fog-banks, Aristarchus was quite distinct as a bright crater, and even before 11h. Grimaldi was plainly discernible."

Mr. Oliver J. Lodge, of Hanley, Staffordshire, says:—"The colour of the moon at the ingress of the shadow was just what might be expected from the mists of the horizon. During the totality it was of a most peculiar dark copper colour, giving very little light indeed. At 10h. 50m. clouds came over very thickly, and I saw no more until 11h. 35m., when the uncovered crescent appeared through an opening in the clouds, shining with considerable brilliancy." He adds: "At the edge of the earth's shadow was a narrow shaded band, from which the moon appeared of a rosy hue. This looked like the shadow of our own atmosphere, but most probably was only due to diffraction."

Mr. William F. Denning observed the eclipse at Bristol, and noticed the copper colour of the eclipsed portion of the lunar disc. At the time of the totality many of the most conspicuous objects on the disc could be distinctly seen with the telescope.

Venus.

Mr. Henry Ormesher observed this planet with his 5¼-in. equatorial refractor, on July 23, at 5 A.M. "Definition was excellent. I observed three dusky spots on the disc, one of which was of considerable magnitude."

Saturn.

Mr. H. Michell Whitley, of Penarth, writes:—"July 7. 10h. 11m. The ball of the planet dull yellow. N. equatorial ruddy belt conspicuous, and another of same colour between it and pole; pole bluish grey. Edges of disc fainter than centre. Sky in ansæ much blacker than around planet. Crape ring across ball, nearly as dark as Ball's division, pale purple. No line of light between it and B."

Meteors.

Mr. J. C. Lambert, of Sleaford—"Observed a very brilliant meteor at 11h. 40m. on July 21. Its course was from a little below γ Cassiopeiæ to ξ Persei. The nucleus appeared as a star of the 1·5 magnitude; tail nearly 2° long; colour, yellowish-white. Duration, 2 seconds. During the time of observation (11h. to 12h. 30m.) observed no less than 11 smaller meteorites. The course of one of these was from ϵ Böotis to 43 Comæ Berenicis, and immediately afterwards one from a little below 43 Comæ Berenicis to η Böotis."

Occultation.

Mr. J. C. Lambert witnessed the occultation of B.A.C. 5954, on July 10, and found that the exact time of disappearance was 12h. 40m. 41s.

Lunar Observations.

Mr. H. Michell Whitley has examined numerous lunar objects during the past month, and the results of his observations have been forwarded to Mr. W. R. Birt.

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THE ECLIPSE EXPEDITION IN DECEMBER.

We trust the Government will reconsider their decision to refuse a ship for this important expedition: although their refusal will not prevent those interested in proceeding to Spain for the purposes of the observation, it will to some extent destroy the prestige otherwise attaching to the matter, and prevent that complete organisation which would certainly have been secured by the whole party proceeding together in one vessel. As to the saving of expense to the astronomers concerned, that, after all, is but a trifle, for we may rest assured that no one joining the expedition but would spend several times the amount of passage-money in the various disbursements he would have to meet before his month or six-weeks' trip was over.

It is the refusal of the Government to help, in a manner which would have been at once gracious and at little cost to themselves, those of their scientific subjects who were willing to put themselves to great expense and trouble for the sake of astronomy, that is so annoying.

The general opinion of the public press, whether siding with the Government or the Opposition, is against this adverse decision. In our last number we inserted an excellent article from the *Daily News* on the subject; and the *Standard* of October 21st contains a spirited leader, holding the same views, and pointing out sharply the loss to English scientific prestige by the course the Government seems disposed to pursue. As the writer of the article well shows, the French nation, owing to their unfortunate difficulties, being unable to do what was proposed in the matter, the observation will be chiefly left to ourselves and our American friends; and while acknowledging their full capabilities in all scientific matters, it was desirable, as some difference of opinion had arisen between them and the English astronomers upon the solar phenomena, that every facility should be afforded of obtaining, on the present occasion, results as accurate and complete as possible. We are sanguine enough even still to hope that the Government will reconsider their determination, and thus give that completeness to the English expedition which the want of a suitable vessel would certainly interfere with.

Popular Astronomy.—It will give you an idea of the information the general public get about astronomical matters when I tell you the following: I purchased a penny *Moore's Almanack* for 1871, in a shop in Exeter to-day. The following is an extract from it:—"In the year 1871 there will be two eclipses of the Sun and two of the Moon, none of which will, however, be visible at Greenwich, nor throughout England: 1, a partial eclipse of the Moon, Jan. 6, 1871, visible only in the Indian Ocean and the North of Africa."

Yours, &c.

A Member of the Observing Astronomical Society.

Oct. 18.

The Astronomical Register is intended to appear at the commencement of each month; the Subscription (including Postage) is fixed at **Three Shillings** per Quarter, *payable in advance*, by postage stamps or otherwise.

The pages of the *Astronomical Register* are open to all suitable communications. Letters, Articles for insertion, &c., must be sent to the Editor, Mr. S. Gorton, *Parnham House, Pembury Road, Clapton, N.E.*, **not later than the 15th of the month.**

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The Astronomical Register.

No. 96. DECEMBER. 1870.

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THE TOTAL ECLIPSE EXPEDITION.

The Government have at last consented to provide a ship and money to the amount of 2,000*l.* for the Total Eclipse Expedition. The delay caused has been most vexatious, but it now seems that the Government must not bear all the blame. A little more energy upon the part of the working committee might probably have brought about this happy conclusion far sooner. A severe article in the *Daily News*, taking much the same view as that of Col. Strange at the last meeting of the Royal Astronomical Society, has called forth the following letter from the Astronomer Royal, which gives a detailed account of the whole matter:—

To the Editor of the Daily News.

Sir,—In reference to your article in the *Daily News* of this day upon the proposed Eclipse Expedition, I take leave to place before you the following facts:—1. Application for aid was made to the Government on June 25. 2. The form of application, and the office to which the application was made, were the same as in numerous preceding instances recognised by the Government. 3. The answer of the Government was given on August 10; it was immediately communicated to the officers of the Joint Committee. 4. On October 21 notice was received that the question might be reconsidered; this notice was communicated to the proper officer of the Joint Com-

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mittee. 5. The Joint Committee took action on this communication as quickly as their constitution permitted, and prepared a second application to the Government on November 4. 6. The result of this is an informal reply from the Government to the purport stated in the *Daily News*.

I am, &c.,

Royal Observatory, Greenwich: G. B. Airy.
Nov. 14.

The question now is, how best to employ the short time that remains for preparation. There must be no further delay in organising each department. A circular has been sent to all of the gentlemen who originally offered to go, to find out who is still prepared to take an organised part in the Expedition. We can only hope that Mr. Airy's earnest appeal to the members of the Astronomical Society to set to work immediately has not been lost, and that by this time the organisation consists in something more than a mere list of names. The Savilian Professor of Astronomy has also invited the members of the University of Oxford to join in the Expedition. We are glad to hear that Mr. Airy, though unable to go himself, still feels bound to the Government and the scientific world to see personally that only fit observers be sent out.

ROYAL ASTRONOMICAL SOCIETY.

Session 1870–71.

First Meeting, November 11, 1870.

W. Lassell, Esq., F.R.S., *President*, in the chair.

Secretaries—Dr. Huggins, F.R.S., and Professor Pritchard, F R.S.

The Minutes of the last meeting were read and confirmed.

One hundred and eight presents were announced, including an exceedingly curious old Latin work by Fontana, which had been obtained by Mr. Ladd at the sale of Sir J. South's instruments. It contains the details of the author's observations with a new telescope he had constructed, and pictures of what he saw, or fancied he saw. Some of these do great credit to the observers of that day. Saturn presents a very remarkable appearance in them. Venus shows a spot, and has a jagged edge. The work was not in the library of the Royal Society, and Mr. Ladd was fortunate in securing it. A vote of thanks to Mr. Ladd and the other donors was cordially passed.

Charles Bird, Esq., Howard Grubb, Esq., and
Francis Barrow, Esq., John Sidebotham, Esq.,
G. F. Rodwell, Esq.,

were balloted for and duly elected Fellows of the Society.

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The President announced that it had at length been determined by the Government to give most efficient aid to the observations of the solar eclipse; that at least one ship would be despatched, and a sum of money not exceeding 2,000*l.* would be appropriated for the other purposes of the Expedition; and should anything occur to prevent the use of a ship, more money for the transport of the observers could be obtained. He also mentioned that letters had been received from the Director of the Marine Observatory of S. Fernando, near Cadiz, and Senor Aguilar, of the Madrid Observatory, offering every assistance to astronomers for the introduction of their instruments, and undertaking to provide chronometers, fix the geographical positions for them, and send time-signals, &c.

Dr. De la Rue: As, in consequence of the former answer of the Government that they could not assist the Expedition, it was very probable many had given up the idea of going after all the time and trouble given by the joint committee to the subject, it was desirable that the news of the changed position of affairs should be as widely and quickly circulated as possible.

Mr. Ranyard: Steps have already been taken with this object. A circular is now printing, and will be sent to-morrow to all those who gave in their names last June as willing to assist.

Professor Pritchard suggested that it would be well to get the leading journals to announce that the Expedition was still going out.

Some further remarks were made by various speakers as to the necessity of limiting the facilities offered to those willing to act under the direction of the organising committee.

The Astronomer-Royal then rose to give an account of what had been done with respect to the Expedition since the last meeting, and said: The way in which I stand related to this Expedition is one which does not allow me to withdraw from the responsibility of seeing that those who go are fit for the objects to be undertaken. The first most urgent want is to know how many desire to go, as upon this depends the sort of ship that can be appropriated for the object. The Admiralty is most anxious on this point, and I have to-day had an officer from the department with me, expressing the desire to aid most efficiently and the greatest good-will. If a sufficient number be found, the Board will probably devote their own yacht, the *Enchantress*, to the object, and will hasten to put on board the necessary stores. I am not at present prepared to say I shall go myself, but I am bound to give every assistance in organising the Expedition. In the next place arises the necessity for what may be termed the scientific instruction of the observers. I regard the official statements as based upon the application made by me in June

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last on the part of the joint committee of the Royal and Astronomical Societies, in which I formally pledged myself and the committee that the Expedition should be properly organised, and care taken that the persons who went should be able to fulfil the objects of the Expedition. This pledge I then took, and it will be understood by the Government that it holds good still. A few words on the history of the transaction may not be misplaced. I was not present at the last meeting of the committee, being in the country, and not in good health. A deputation was then resolved on, but, so far as I was concerned, it was out of the question; and therefore Sir E. Sabine suggested that I should apply to Mr. Childers, the First Lord of the Admiralty. This was quite in accordance with my experience and practice in former cases, but facts have since come to my knowledge which make me believe that the present Government have made departmental changes and regulations which render it desirable to address the Treasury in the first instance. In answer to that application, after six weeks' delay, I received a letter—where it came from I do not know, and do not care to enquire, as I believe it did not really express the views of the First Lord and the Board; but its tenor was such that though it referred me to the Treasury as the proper channel of pecuniary assistance, I thought it useless to move further in the matter. What has since been done to show a different disposition, Mr. Lockyer knows best. This day week another meeting of the joint committee was held, when it was resolved to send a deputation to the First Lord of the Treasury, explaining the circumstances, and asking him to obtain a ship from the Admiralty and money from the Treasury. Something was expected from this, but up to the Council meeting to-day nothing had come of the letter asking for an interview, and the matter seemed at a dead-lock; but, thanks to our excellent Fellow Mr. Lockyer, who this afternoon saw the Chancellor of the Exchequer, the object was now attained. The Government has recognised the right of the men of science to look to it for assistance. I am not at liberty to mention the details, but the aid will be ample. We must now work hard to get things in order as quickly as possible. The first point is to obtain a list of observers and their destination, and then to provide instruments and superintend the training of the members of the Expedition. Should further information be required, I must refer to Mr. Lockyer.

Professor Pritchard produced a classified list of those formerly willing to go on the Expedition, with the departments selected by them, but remarked that whether their intention still held good was quite another thing.

Col. Strange said that a list of observers did not constitute

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organisation, and suggested that these gentlemen should be brought together, to see what each could undertake. The best plan would be to convene a meeting of each class, and let them arrange their own affairs.

Dr. Huggins: The names read do not contain the whole of those assisting in the matter. There are several gentlemen who, although not pledged to go, will do good service in organising the Expedition.

The President: I fear there will not be time for a meeting of the observers before they assemble to depart. The circular now preparing will soon ascertain how many are still going.

Dr. De la Rue: The whole business of organisation is now in the hands of a sub-committee of leading men appointed by the joint committee.

The Astronomer-Royal: I dread large committees. The fewer hands it can be confided to, the better.

Professor Pritchard read the names of the Finance and Organising Committees.

Mr. Ranyard: The circular now in the press states that the names of those gentlemen willing to go, and approved by the committee, will be sent to the Admiralty.

Capt. Noble: But this brings us no nearer the mark. We want to know what each will do, and distribute the observers.

Professor Pritchard: Surely the Organising Committee will perform what they have undertaken.

Col. Strange: There must be no risk of a fiasco. Unless the volunteers meet and decide what work is to be done, and with what tools, the opportunity will be lost.

Professor Pritchard: Is the Astronomical Society prepared to supersede the joint committee and the present organisation?

Col. Strange: If this Society is not prepared, or has not the power, to give directions, we had better proceed to read the papers before us.

Dr. De la Rue: The application to the Government was made in the joint names of the Royal Society and the Astronomical Society, and one cannot act alone. Besides, for a meeting like this to discuss the arrangements, would last till the eclipse was over.

Professor Pritchard: If the letter be despatched, and the answer promptly sent to the committee, the end will be accomplished.

The subject then dropped, and the Astronomer-Royal proceeded to make some observations on several matters. One was the necessity for astronomers, and especially foreign ones, packing their papers in stronger covers. He would especially urge this on his American friends. The confusion caused was extreme.

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He had lately received a Belgian newspaper in a cover which should have contained meteorological observations from Italy, and the disappointment to both parties, astronomer and politician, might be conceived. He also wished to refer to a small pamphlet called *Solar Fictions*, by a Mr. Freeman, which might be a fictitious name, and which showed that all persons at least were not displeased at the Government refusal to aid science. The book was to prove that there was no such thing as the sun, and the cover had a hand carrying an extinguisher to put out that luminary. This was not done in the spirit of metaphysics, which taught that things we saw were unreal, but in a more direct sense. He read extracts from the work, which stated that it was a cheering sign of the times that Government aid to received astronomy would be withdrawn, and no Eclipse Expedition sent; and after much abuse of the science, expressed a hope that Ministers would soon bring in a Bill to disestablish the Greenwich Observatory, and apply the funds to the endowment of the Earlswood Asylum for Idiots. "Now," said the Astronomer-Royal, "I may be an idiot, because I get a salary for it, but you gentlemen must be born idiots, I suppose."

Dr. Mann had heard something like this before, and thought the writer was the person known as "Parallax."

The following papers were announced and partly read:—

On a Standard or Uniform Measure of Time: by Captain Drayson. This was an elaborate paper, illustrated by diagrams and tables. The author said there was a necessity for an uniform measure of time, in order to compare observations made at different periods. The rotation of the earth on its axis was usually selected, but, in consequence of the alteration in the obliquity of the ecliptic, this was not constant. The only uniform period was that in which the pole of the earth revolved round the pole of the ecliptic; but this took upwards of 25,000 years, and was too large for a unit. He wished to obtain from this the true value of a mean sidereal day; for which purpose he must define the position of the centre of the circle, and the rate at which the pole revolved. The pole does not move in a circle at the same distance, as popularly imagined, or the obliquity of the ecliptic would be invariable; whereas, for the last 1,800 years, it had been decreasing, so that the interval between meridian transits of stars did not give an exact value. He had devoted a considerable time to these subjects, and worked out by spherical trigonometry the place of the centre of the revolution, and found it at a different point to what had usually been received. From this he deduced the obliquity of the ecliptic at different periods, and found them agreeing with the observed results in the most accurate manner. In some cases where they differed, the wrong corrections for refraction had been used by

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the observers. Calculations traced back to 13,000 B.C. showed that certain geological changes might be caused by these actions.

Professor Cayley enquired whether the author sought to establish any difference between his formula and the ordinary formula for precession? Whether the paper was an interpretation of precession, or intended as a correction of it; if so, on what data it rested?

Captain Drayson said his results corresponded with the ordinary ones, except in one instance. On the present theory the motion was considered uniform, and the amount of precession was found by adding so much per year or per century, which was only empirical. Whether his idea was right or wrong, it gave correct results.

Professor Pritchard: Surely the law of precession is not empirical. If anything was definite, he thought the theory of precession was.

Captain Drayson: If you want the place of a star for 1900, you would add so many seconds per year.

Professor Pritchard: But not empirically; because it is the result of the theory.

On an Automatic Spectroscope for Dr. Huggins: by Mr. Grubb.

Dr. Huggins stated that, unfortunately, the instrument itself had not arrived, but by help of a diagram he could explain the construction. It consisted of four compound prisms and two half-prisms. The telescope and collimator were both fixed, and each prism was automatically moved, so as to remain at the minimum angle of deviation for each ray. After traversing the whole range, the rays were reflected to a different level, and went back through the prisms, doubling the dispersion, and getting 90° between A and H. The instrument, though only just completed, was contrived and modelled in March of this year, and as Mr. Browning and Mr. Proctor had both been at work on the subject, it was due to Mr. Grubb to mention this date.

Mr. Lockyer: In a question so important as the use of the spectroscope, it is desirable not to cloud it by discussion of priority in arrangements. The great point is to utilise the instrument, and obtain great dispersion in the best possible position. Professor Young, of the United States, has elaborated a model devised by myself and a friend with excellent results. If the prisms be fixed to a solid plate, the effect in some positions is good, in others not so, especially at the extremes of the spectrum. Mr. Hemming suggested that a great deal of the inconvenience would be got rid of by mounting the prisms on springs, not plates, and that the telescope should move the springs so as to give the minimum angle of deviation of the line to be observed and recorded. It also occurred to me to have a reflector at the

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end of the train, and so use the prisms over again, making seven do the work of fourteen, and so doubling their power. I am delighted to hear from Professor Young that he has thus obtained superior dispersion to any result in this country. The arrangement of the springs is a matter of great difficulty, but Mr. Becker in America seems to have pretty well solved the problem. We are indebted to Mr. Browning for his excellent mechanical arrangement. Whichever plan is adopted, it should be simple, as at eclipses we are far away from such mechanists as Mr. Browning and Mr. Becker.

Professor Simon Newcombe, having been introduced to the meeting, thanked the Fellows for their kind reception of him, and expressed his gratification at seeing with the eye of sense many whose names were in America "familiar as household words."

On a Contrivance for extending the Principle of Mr. Browning's Automatic Spectroscope to a Second Battery of Prisms: by Mr. Proctor.

On the use of Eye-screens in Telescopic and other Researches: by Mr. Proctor.

On the Laws of Star-grouping: by Mr. Proctor.

In referring to the first of these papers, the author said he quite agreed that the question of priority ought not to enter into the matter. The reflection of the rays back again through the battery of prisms was an old idea. He drew a diagram, and explained his method for accomplishing this object.

The paper on star distribution he would leave to be considered when in print.

The paper on eye-screens had relation to eclipse and other special observations. He recommended a curtain or soft black tube from the eye to the telescope, which, after being used for a time, would increase the sensibility of vision for delicate observations.

Dr. Huggins said he had tried a pair of railway spectacles, from which he removed the glasses and covered the gauze with dark material, but found the moisture and heat collected in the confined space hurtful and inconvenient. The best preparation he knew was to lie down for a short time in a completely darkened room, by which the eye gained its extreme of sensibility.

Mr. Proctor intended to say that his suggestion applied only to special observations for a short time. If necessary, the covering might be ventilated in some way.

Capt. Noble said that the practice of occluding one eye as used by many persons was quite unnecessary, and the dispensing with it a matter of education. Being shortsighted with the left eye, he worked with the right, and the other did not seem to see

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surrounding objects, the attention being concentrated on the object in the telescope.

The President: Your short sight of the one helps this being not so good for seeing surrounding bodies.

Mr. Proctor: Most observers keep the spare eye open, but covering it improves the vision, as the eyes appear to sympathise.

The President: It should not be done with the hands.

On the performance of a Zenith Sector constructed for the great Trigonometrical Survey of India: by Col. Strange.

The author said: The Fellows are generally aware that I have on several occasions alluded to instruments constructed from my designs, and one having been sent out to India and reported on by Lieutenant Herschel, the officer entrusted with its use, I thought the Society would be interested in hearing how the instrument performed. It has been known for about 100 years that mountains affect observations with astronomical instruments by attracting the plumb lines, and thus disturbing the result. More recently it has been found that even where there are no mountains disturbances may arise. Of these cases a striking example was narrated in this room by Otto Struve several years ago, where, in the flat country round Moscow, some marked effects upon the instruments being followed up led to a clear demonstration that beneath the surface there existed either a vacuity or a mass of much lighter matter than the general strata of the district. Now, as the form and dimensions of the earth depend upon the exactness with which the latitudes are determined, and as these cannot be ascertained without some reference to gravity, and as this gravity is rather indefinite in effect, experience shows that we must allow for these disturbances. Professor Pierce, of the U.S. Coast Survey, has also found effects from changes in gravity away from mountains. To throw light on this problem Sir A. Waugh and Colonel Walker determined to multiply latitudes in the Indian survey, and to combine such astronomical latitudes with those obtained by triangulation, which fortunately are not affected by gravity. The Indian Government having sanctioned a fresh supply of instruments for this purpose, I was selected to design them. The old form of zenith sector was cumbersome and complicated, and may be found described in *Pearson's Astronomy*. Ramsden's had a telescope of 8 feet long suspended in a frame 12 feet high. This was followed by one designed by the Astronomer-Royal for the survey of Great Britain, of which I exhibit a drawing. When called upon for an instrument I should have fallen back upon this but for its great weight, which, with a 4-feet telescope, comes to 1,140½ lbs., without the packing-cases, and requires a very substantial support. I wanted equal

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power and less weight; so I went to Southampton, and, by the kindness of Sir H. James, thoroughly studied Airy's sector. I took it to pieces and put it together again, and then made up my mind on two points: 1st. Not to adopt the principle at all, on account of the enormous weight; and 2nd. Not to attempt any improvement on his method of observing, which was as perfect as possibly could be. I designed the instrument on paper and took it to the Astronomer-Royal, who, with his usual kindness, went into all the details and approved it in general, though he still preferred his own form. I mentioned my objection to the weight, when he asked if mine were really lighter. I answered I believed it was, and it looks so in the drawing I show you, and upon returning I sat down to calculate the weight. It took me a fortnight, and the resulting weight was 600 lbs., about half that of the other. When the sector was completed I was very anxious till it was weighed, and I then found I was only $4\frac{1}{2}$ lbs. out. In using Mr. Airy's the telescope has an azimuthal motion, as a star has to be observed E. and W. of the meridian at one culmination. Mine has a stiff pillar carrying the horizontal axis of motion of the telescope [a model was shown]. This will turn half round on the vertical axis to get the two observations of one star. The sectors are portions of a circle 3 feet in diameter. They are read by four micrometer microscopes on the bevelled edge, as in the Greenwich transit circle. The instrument was carefully examined, and sent out in October last by the Overland Mail. It reached Bangalore in November 1869, and I was very anxious to hear how it behaved. I was not long kept in suspense. Lieut. Herschel writes that between March 20 and April 4 he had measured a base line. From his letter I read a few extracts. He says: "I am now observing my 6th station, and have taken between 1,000 and 1,200 zenith distances. I speak without hesitation of the facility and comfort with which it is used—indeed, it is difficult to find a fault." Three points required to be particularly noticed: 1st. The symmetry of the instrument; 2nd. The character of the instrumental errors; and 3rd. The accuracy of the results. Lieut. Herschel states that five minutes is his limit for closing a star list. He could be quicker, but not with such precision. This implies excellence in the instrument and the greatest skill in the observer. He has 24 operations to perform in this time, including setting, reversing, looking and reading, &c. There appears nothing to adjust. The run of the screws and the focal distance remain constant, and the graduation done by Mr. Simms's engine seems almost perfect. No error exceeds 2″, and as each division occupies 4″, the error is half a fine scratch, or, in other words, as one second is the 11,000th of an inch, the quantity in question is only the 5,000th

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or 6,000th of an inch out on the metal plate. No instrumental error is more than 1″ after six or seven hours' work. With respect to accuracy of results, he states that 50 stars are observed at each station, and each one three times, and that the error is within 1″ for each triplet. As a total result at the last station 22 *Nautical Almanack* stars were observed, and, leaving out Procyon and γ Virginis, the other 20 agreed within 1″·6. "This accuracy," he says, "has no parallel in my existence, but in other hands it may do better." I (Col. Strange) cannot but testify to the extraordinary skill of the observer. The best tool is useless in bad hands. Lieut. Herschel thinks the error may be reduced to 0″·2, and suggests a few improvements which will be made. Some time ago Mr. Simms exhibited here an instrument known as the American one for getting differential zenith distances. I requested Lieut. Herschel to try this plan, but he says it is a waste of power with such an instrument. I have discussed this with Professor Pierce, who uses this method almost exclusively, and I pointed out how time is saved by getting your result at one observation, whereas one of two stars may be lost by bad weather. The absolute method also admits of observations by two instruments on the same star on the same night, and is therefore independent of the places of the stars. Professor Pierce assented to this view, and took copies of my photographs to recommend the adoption of the instrument in America. When called upon to undertake the construction of new instruments, I laid it down as a principle that no inspection of such could be considered complete which did not include using the instrument for the very observations it was intended to take. The best makers do not and cannot apply this test. No maker in Great Britain has an observatory fit for this, and if he had, he could not spare the time. Instruments are, therefore, only examined and not inspected. The proof of the soundness of my plan is that this sector, the first instrument sent out of whose performance I have any knowledge, could be used at once without the necessity of the slightest modification.

On a Photograph of Jupiter: by Mr. Browning.

The coloured drawings were exhibited, but the paper and the following ones could not be read:—

On the Spectrum of the Aurora Borealis: by Mr. Browning.

On a point in Egyptian Chronology: by Mr. C. Abbé.

Further Observations on the Currents of the Solar Photosphere: by Mr. Weston.

On the Aurora Borealis of Sept. 24, 1870: by Admiral Ommaney.

Observations of Coggia's Comet: by Mr. Perry.

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Occultation of Saturn by the Moon, Sept. 30, 1870: by Mr. Prince.

On Periodical Changes in the Physical Condition of Jupiter: by Mr. Ranyard.

The President stated that the index to the first 29 volumes of the publications of the Society was completed, and would be distributed gratuitously to all Fellows applying for it, but could not be sent by post.

The meeting then adjourned at a late hour.

AURORA BOREALIS.

The extraordinary beauty and unusual intensity of the Auroral displays of October justify us in once more reverting to them. Correspondence from all sides has poured into the papers upon it, describing the various emotions and feelings excited by these lovely phenomena. From the seat of the war we hear how the poor stricken peasants looked up to them as to a sign in the heavens of the blood of their citizens, which was being spilt like water on the face of their land. In more fortunate countries the sight has been a delight to thousands, and many useful notes have been recorded. It was seen in England and Scotland, in France, Italy, and Greece; the intense red colour being noticed in all these places. An article in the *Pall Mall Gazette* gives an interesting historical notice of the appearances of these phenomena in former times, and of the effect on the nerves and feelings of our forefathers.

In a work by M. de Mairan, entitled *Traité physique et historique de l'Aurore boréale*, published in 1754, is given a record of all the observations of Aurora from the *sixth century down to that date*, as far as they appear upon the page of history. The gross number of distinct phenomena enumerated by M. Mairan amounts to 1,441, distributed as follows:—From A.D. 583 to A.D. 1354, 26 were observed; 1354 to 1560, 34; 1560 to 1592, 69; 1592 to 1633, 70; 1633 to 1684, 34; 1684 to 1721, 219; 1721 to 1745, 961; 1745 to 1751, 28. Distributed according to the months, there were in January, 113; February, 141; March, 202; April, 124; May, 45; June 22; July, 22; August, 84; September, 172; October, 212; November, 153; December, 151. The instances in the winter half-year amount to 972, and those in the summer to 469, being nearly in proportion of two to one in favour of the former.

Old Stow describes that which took place on the 14th of November 1574, and says that there "were seen in the air strange impressions of fire and smoke to proceed forth from a black cloud in the north towards the south. That the next night the heavens from all parts did seem to burn marvellous ragingly, and over our heads the flames from the horizon round about rising did meet, and there double and roll one in another as if it had been in a clear furnace." The year following, 1575, it was twice repeated in Holland, and Cornelius Gemma, a professor in the University of Louvain, thus describes the second appearance in that year:—"The form of the chasm on the 28th of September, following immediately after sunset, was indeed less dreadful, but still more confused and various; for in it were seen a great many bright arches, out of which gradually issued spears, cities, and towers, and men in battle array; after that there were excursions of rays every way, waves of clouds, and battles mutually pursued and fled, and wheeling round in a surprising manner."

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The correspondent of the *Echo* declares that no display has been visible at Rome since 1848, and, as might be expected, that it was regarded by the people there with wonder and awe. The light upon the Italian lakes is said to have been very splendid; the Lago di Maggiora was of a blood-red colour. From W. by N. to N.E. by E. the sky was a brilliant rose, a circle of about 140 degrees of pulsating flames, varying in height from 40 to 60 degrees, the portion from N. by E. to N.E. by E. being exceptionally bright; the next brightest portion being that to the extreme western end. At 9.20 it was at its most brilliant period. In another five minutes the inner portion of the vast arc had become faint, when in an instant there shot out in all directions bright steel-coloured streamers, many of which reached the zenith.

In England, one of the most noticeable features was the dome-like appearance of the streamers—as distinctly marked as the longitude lines on a globe, or, as some one has remarked, like the ribs of an open umbrella—culminating somewhat south of Vega. One of the most important observations of the Aurora was its effect upon the telegraph. Mr. Culley, engineer of telegraphs to the Postmaster General, gives a full and very interesting account in a letter to the *Times* of October 31st. He says that the Aurora is in fact a kind of lightning, different from ordinary lightning only in its being a gentle and gradual flow instead of a violent and sudden discharge, similar to the currents that pass from one part of the earth's surface to another. The earth currents were especially active during the late brilliant displays, so that at the central office they were obliged on Tuesday to loop 50 wires, thus losing at once 25 circuits.

Mr. J. Birmingham sends us an interesting article, reprinted from the *Galway Vindicator*, upon this subject.

THE AURORA BOREALIS.

As observed by Professor Donati.

Last night (24th Oct.) a most splendid Aurora was seen in Florence. About 8h. 20m. I began to perceive a faint reddish light in the north. It gradually increased, and at 8h. 50m. the phenomenon of the *Aurora* displayed itself in all its magnificence. A great luminous arch of the warmest crimson tint (like that which clouds often have near sunset) began at the north-west, near the constellation Hercules, rose as far as the Polar star, and terminated at the north-east in Bootes; it was afterwards traversed by long and most vivid rays of white light, which appeared and disappeared at intervals. The spectacle was really wonderful, especially for me, who was observing it from the heights of the new observatory of Arcetri, and not disturbed therefore by the light in the streets of the city, which is always injurious to any celestial observation. The sky in the south was entirely covered by very dense clouds; in the east there was a succession of very vivid flashes of lightning; from N.E. to N. there were large broken clouds, amongst which the light of the Aurora appeared in all its splendour. In less than half an hour it was also traversed by five large and very beautiful falling stars, all radiating from the constellation of Perseus.

The reddest and most quiet part of the Aurora was that towards the east; whereas the western part changed its appearance continually, and from red passed to white, and then at about 9h. 15m. appeared of a greenish colour. From that moment the phenomenon began to diminish in intensity, and at 10h. it was entirely ended.

It must also be remarked, that whilst here in Florence, from 6 o'clock of the evening of the 23rd, and during all the night and day following, there

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had blown a very strong south-west wind (hibeccio), which continued to rage with great impetuosity even during the phenomenon of the Aurora, it ceased instantaneously as if by magic when that phenomenon had scarcely ceased to be visible.

The magnetic needle of the Florence observatory indicated a sudden diminution of the magnetic declination.

It has been announced this morning by telegraph that the Aurora was also observed at Lyons, Turin, Milan, Genoa, Leghorn, Naples, Otranto, Catania, &c. The telegraphic instruments, however, suffered no disturbance; only at Otranto there was noticed a momentaneous constant current.

Florence: Oct. 25, 1870.

AURORA.

On Oct. 20th, at 7 P.M., there was every appearance of a fine display. Masses of black cloud covered much of the northern sky. But at 7.30 the sky was clearer, and a bright red magnetic cloud lay in Auriga; a little later it was in the Lynx. The large stars in the back of Ursa Major, and the Northern Crown in the W., marked out the upper limit of the bright segment to the westward. At 10 P.M. the arch of fiery red magnetic clouds was well seen: it extended from N.E. to W. No bright columns were seen this evening.

On Oct. 24th, after a wet windy day, the sky cleared a little at intervals during the evening. At 8 P.M. huge black clouds lay above the horizon in the W., N.W., N. and N.E. But soon after this hour both the dense clouds and the clear sky in the N. were lit up by the bright red and pink Auroral light. At times the colour was very intense and attracted the attention of all and excited the fears of many. The clouds grew more dense, and soon the awful scene was hidden from view. At 9 P.M. the northern sky was very bright when seen, rain fell fast, but neither coloured clouds nor bright beams were observed.

On the 25th, after a fine morning, showers began to fall, and thunder was often heard from 3 to 4 P.M. Heavy showers of hail fell at 4.30, 6, 7.15, and 8.45 P.M. Rain also fell heavily during the evening. About 6 P.M. the Aurora was first seen. The dense clouds in the N. became dull red, a broad red arch spanned the sky from E. to W. through the zenith, and bright rays shot up to the zenith from the horizon in the N.W., N., and N.E. Broad streaks of red penetrated the dark sky S. of the zenith. At 6.45 all the red clouds lay to the E. of a line drawn from the zenith through Cassiopeia and Auriga. At 7.10 no red sky was seen in the N., but the constellation Aquila was half hidden by the fiery cloud. At 10.45 one long broad beam lay across the sky from E. to W.

JOSEPH GLEDHILL, F.G.S., F.M.S.

Mr. E. Crossley's Observatory,
Park Road, Halifax.

Mr. Lawton writes, that "the splendid Aurora Borealis on the evenings of the 24th and 25th ultimo were both favourably seen from Hull, and observed by myself and others, though short their continuance. On both occasions the deep crimson masses of light in the N.E. and S.W. (the latter frequently obscuring the constellation Aquila), and the Coronæ south of the zenith were, as seen from Hull, the characteristic features of the streamers. Mr. Gledhill, I see, alludes to telescopic definition having been impaired during the Aurora of the 24–25th Sept. last. I experienced a similar want of definition when using a 7ft. 7in. Newtonian on the 25th Nov.; also, but to a less extent, with a 22-in. by 2-in. refractor by T. Cooke

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& Sons. In addition to this want of definition there appeared a partial obscuration arising from the intervention of smoke-like vapour, the prevalence of which I have noticed before during an Aurora."

THE LUNAR CRATERS ARISTARCHUS AND HERODOTUS.

By W. R. Birt, F.R.A.S.

The observations of these craters, and especially of the "brush of light" by Mr. Whitley, recorded on page 194 of the September number of the *Astronomical Register*, with Mr. Whitley's remarks, are so valuable and important that it may assist in extending our knowledge of this part of the moon if an examination of the drawings of Aristarchus which I possess be placed on record.

(1.) Schröter. 1787, October 7. Evening illumination. Brush distinct. N.E. side illuminated, *dark line* within brush.

(2.) Schröter. 1789, December 28. Morning illumination. Brush well marked, *with line of shadow within.* Interior of Aristarchus ½ in shadow; Herodotus wholly so. Herodotus, as drawn by Schröter, has a small crater *on* its W. border, which does not appear in a drawing which I possess between 1860 and 1870. Phillips's drawing (*Philosophical Transactions*, 1868, plate XVII.) has a notch on the W. border. Schmidt, 1866, has a small crater on the N. border. The shadows in Schröter's drawing adjoining Herodotus indicate the locality of the "brush" to be the summit of a ridge, the N.E. slope being very steep, extending S.E. from Aristarchus.

(3.) Birt. 1860, April 2. Shadow of Aristarchus 0·7, the opening of the crater = 1·0. Brush clearly the summit of a ridge, the N.E. side very steep. At the N.W. end of the ridge, close to Aristarchus, is a depression, probably very shallow, indicated by Schröter, Dobie, Ingall, Grover, and Phillips, but in no instance shown so distinctly as on April 2, 1860.

This drawing was made for the purpose of showing the double western crest alluded to nearly 8 years afterwards by Phillips.

(4.) Dobie. 1863, July 30. Moon a little past full. Brush absent. Crater-rings of Aristarchus and Herodotus exceedingly distinct, also the ridge between them well marked. With these exceptions, hypsometrical features are absent.

(5.) Ingall. 1866, April 26. Aristarchus ½ in shadow, similar to Schröter's drawing 1789, December 28. Brush absent, but the shadows clearly manifest that Herodotus is situated on the N.E. of a surface gently sloping to the S.W.

(6.) Ingall. 1866, June 25. Shadow of Aristarchus 0·25. S.W. slope of ridge more strongly illuminated than the surface still further S.W., but the "brush" as often seen absent.

(7.) Schmidt, 1866, in his "Rillen auf dem Monde," gives a spur extending south-easterly from Aristarchus on the S.W. side of Herodotus. On the S.W. side of this spur he gives a rill (12) which probably answers to Schröter's *dark line.*

(8.) Grover. 1867, December 7. Shadow of Aristarchus 0·9, part of ridge very steep on E. side; double western crest well shown.

(9.) Phillips. 1868. Double western crest, and S.W. slope of ridge shown as illuminated, but "brush" as such not shown.

(10.) Browning. 1868. Early illumination. Shadow of Aristarchus 0·16, ring very distinct, no appearance of ridge connecting Aristarchus and Herodotus, but the shallow valley indicated by Schröter between the two craters and running towards the serpentine valley, is well shown on the

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raised plateau mentioned by Mr. Browning, although the general brighter illumination of its S.W. slope is not given. Brush entirely absent.

(11.) Browning. 1868. Full illumination. Crater-ring of Aristarchus not traceable. The nebulous patch of light, probably the same as the "brush," is placed on the S.W. of Aristarchus, and does not connect it with Herodotus.

There are numerous other features on the drawings which may probably arrest the attention of future observers.

CORRESPONDENCE.

N.B.—We do not hold ourselves answerable for any opinions expressed by our correspondents.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

A DAYLIGHT OBSERVATION OF METEORS.

Sir,—I cannot agree with Mr. Bird's explanation of the appearances I have described under the above title in the October *Register*; at the same time, I do not see that I can add anything to what I have there stated. I will, however, though at the risk of a little repetition, endeavour to point out a few particulars which are, I think, quite fatal to the snow-storm theory.

I will first consider the motion in the two cases. Mr. Bird says of the snow-flakes, "they sail across the field of view like feathers in the wind." This is very different from the motion I observed; and, although I say they sailed across the field of view, the movement, instead of the easy slow flutter of the feather, was a straight and rapid transit, and had it not been for the unusually large field, nearly $1\frac{1}{2}°$ of the comet eyepiece, I could not have kept them in view sufficiently long to note the various particulars I have described. In the ordinary low-power eyepiece with a field of about half a degree, their passage would have been almost momentary.

Mr. Bird, speaking of snow-flakes, says "that they are very high up in the atmosphere is evident, for little or no alteration of focus is necessary between them and the celestial bodies." This, I must candidly confess, is quite contrary to my own experience. Only quite recently I was witness of a tremendous snow storm while observing the sun. The flakes gliding over the disc which was central in the field, I then found a distinct and very considerable alteration of focus was required to bring the snow-flakes into distinct vision, the eyepiece requiring to be withdrawn, as every observer finds is necessary for near objects; and it was because I found in my late observations that though the eyepiece required pulling out, yet it was to a much less extent than is required for the snow-flakes, that I considered the bodies observed were at a much greater distance, though not so remote as the sun itself.

I do not see anything improbable in being able to see meteors very near the sun. The planets Mercury and Venus are often seen when thus circumstanced, and, as we know, many meteors exceed either of these bodies in brilliancy.

In conclusion, I would draw attention to my description of a well-defined disc and the distinct indications of combustion, also to the glare caused by some in their transit, all of which must I think, tend to strengthen the evidence as to the reality of my Daylight Observation of Meteors.

I am, yours very truly,

Clapham: Nov. 4, 1870. CHARLES GROVER.

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NEBULA IN ORION.

Sir,—Would you draw the attention of observers to the desirability of observing the nebula in Orion during the ensuing apparition, to see if any stars are visible in the interior of the trapezium (not the 5th or 6th), of which there are several recorded observations, although not shown in Lord Rosse's drawing, and if, as is suspected and probable, they are variable, may be again seen? They were seen in 1866–67 with moderate instruments, but I cannot find recorded observations since that time. And also as to traces of nebulosity in and closely around the trapezium, which has been observed by Secchi and others at times.

If your space is not closed on the Moon's rotation subject, allow me to ask the non-rotationists what decision on that subject would be come to by a Lunarian, who is located on the side away from the earth, who has had no intercourse with his fellows (if any) on the side next the earth, and consequently is ignorant of the primary's existence, and knows enough of science to define rotation?

Yours truly,

46 Fountain Street, Manchester: S. S. BROUGHTON.

Oct. 21, 1870.

OCCULTATION OF SATURN.

Sir,—Notwithstanding the tremulous state of the atmosphere, the occultation of Saturn on September 30th was favourably observed here; the immersion with my 8-inch equatorial reflector, and the emersion at the observatory of W. E. Jones, Esq., with his splendid Dallmeyer equatorial of 5 inches aperture, long. W. about 38s., and the difference between the two stations 30 feet.

The following are the local sidereal times:—

Immersion.

	h.	m.	s.
Outer edge of A, western ansa	18	40	5
Inner edge of B "	"	"	23
Western edge of ball	"	"	34
Eastern "	"	41	12
Inner edge of B, eastern ansa	"	"	22
Outer edge of A "	"	"	39

Emersion.

Outer edge of A, western ansa	19	54	11
Inner edge of B "	"	"	29
Western edge of globe	"	"	40
Eastern edge of globe	"	55	18
Inner edge of B, eastern ansa	"	"	29
Outer edge of A "	"	"	48

Yours truly,

18 Preston Street, Brighton: HENRY PRATT.

Nov. 14, 1870.

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D'ARREST'S PERIODICAL COMET.

Sir,—From his communication in your last number, it would appear that Mr. Chambers is unaware of the fact that D'Arrest's comet has been seen by several observers during its present return to perihelion. It was examined by Mr. J. R. Hind at Mr. Bishop's observatory, Twickenham, on September 23, 24, 25, and 26. It was also recognised by Mr. Hale Worthan, of Royston, on September 25. A letter from Mr. Hind having reference to the comet appeared in the *Times* of September 28, and it will be appropriate to quote a portion of it here. He says: "We have succeeded in obtaining observations of D'Arrest's comet of short period (first recognised in 1851), though it is an object of extreme faintness, and could be steadily seen only in a first-class telescope. Knowing that it had been sought unsuccessfully with powerful instruments at several foreign observatories, and only once suspected to be glimpsed by Dr. Winnecke at Carlsruhe, we had small expectation of detecting it here. The evenings lately have, however, been unusually favourable for astronomical purposes, and I had proof on similar occasions during the last 25 years that Mr. Bishop's object-glass, worked by Dollond, is one of first-class excellence, and as nearly as possible perfect in its performance for its aperture. For the sake of brevity, I give the result of one only of the four evenings' observations, which we consider the best, viz.:—September 25, 7h. 32m. 23s. mean time at Twickenham; Right Ascension, 17h. 58m. 50·02s.; Polar Distance, 111 deg. 14 min. 17·6 sec. The mean correction to the ephemeris by M. Leveau of the observatory at Paris is—24·49 sec. in R.A., and 1 min. 39 sec. in N.P.D."

Mr. Hale Worthan (member of the Observing Astronomical Society) of Royston, in a letter to me, says the comet was "very distinctly seen here early in the evening of the 25th of September. It was very faint, too faint to allow of any illumination of the wires of the micrometer, and there was not any known star placed for comparison by means of a ring micrometer. Its position was, therefore, only read roughly off the setting circles, and was as follows:—Local sidereal time, 19h. 54m.; Right Ascension, 17h. 43m.; South Declination, 20 degrees 17 minutes."

The small telescopic comet discovered by M. Coggia, at Marseilles, on August 28, has been observed by many observers. Several of the members of the O.A.S. have succeeded in detecting it, and the results they have obtained will be included in the next report of observations made by the members of the Society.

I am, Sir, truly yours,
WILLIAM F. DENNING,
Hon. Sec. Observing Astronomical Society.

Ashley Road, Bristol:
November 8, 1870.

SUN-SPOT PERIOD.

Sir,—In the September number of the *American Journal of Science* there is a long article by Prof. Loomis on the period of solar spots and their connection with magnetism and auroras. His table of maxima and minima differs somewhat from Wolf's, as given by A. Elvins on your p. 224; especially in that he inserts an additional minimum and maximum between 1787 and 1798. He considers that there were minima in 1775, 1784, 1793, and 1798·5; and maxima in 1778, 1787, 1794, and 1804.

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This makes the average period of solar spots 10 years, instead of 11, the commonly received average. Prof. Loomis gives the relative amount of spotted surface of the Sun for each year from 1740 to 1869. I have arranged the numbers he gives in equal periods, and find that the average spotted surface for each year of a 10-year period may be represented by the following numbers:—

24·8, 25·1, 31·8, 43·9, 53·2, 61·6, 53·6, 44·1, 32·8, 24·6.

Or, for each year of an 11-year period, by these:—

22·9, 24·3, 27·8, 40·0, 56·9, 61·4, 60·3, 46·5, 37·4, 31·7, 27·9.

There is not much to choose between the 10-year and the 11-year period. I incline to the latter; but the period is really irregular.

I am, yours truly,

Sunderland: Nov. 12, 1870. T. W. BACKHOUSE.

ECLIPSE OF THE SUN.

A total Eclipse of the Sun will take place upon Thursday the 22nd of December, partially visible at Greenwich.

GREENWICH MEAN TIME.

		h.	m.
Beginning of the Eclipse	December 21,	23	7·7
Greatest Phase	„ 22,	0	25·1
End of Eclipse	„ 22,	1	42·1

Magnitude of the Eclipse (Sun's diameter = 1) 0·814.

Although this Eclipse will not be total in England, yet it will be so considerable, and happens at so convenient a time in the day, that all possible preparations should be made for obtaining satisfactory observations of it. We therefore refer our readers to some hints on the subject given at p. 78 of No. 5, in our first volume, as we feel sure that no precaution taken to ensure success will be thrown away if the weather should prove favourable for observing this important phenomenon.

NEW VARIABLE STAR.—At the last ordinary meeting of the Hackney Scientific Association, held on Nov. 8th, Mr. Henry T. Vivian announced that he had discovered the variability of ϵ Hercules, a small star N.E. of π. From observations extending back to the autumn of last year, he had deduced a period of about 21 days, with probably a second longer period. The amount of variation in the star's magnitude is from a large 5th to a small 6th. The star is numbered 60 in map 10 of Mr. Proctor's New Star Atlas, although in map 8 it is numbered 69, an error probably on the part of the engraver.

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ASTRONOMICAL OCCURRENCES FOR DEC. 1870.

DATE		Principal Occurrences		Jupiter's Satellites		Meridian Passage
		h. m.			h. m. s.	h. m.
Thur	1	10 23	Sidereal Time at Mean Noon, 16 40 33·8 Conjunction of Mars and σ Leonis, 3m.6 W.	2nd Ec. D. „ Oc. R. 1st Sh. I. „ Tr. I. „ Sh. E. „ Tr. E.	5 9 14 8 21 15 46 16 4 18 1 18 18	Moon — 7 29·3
Fri	2		Meridian Passage of the Sun, 10m.23s. before Mean Noon	1st Ec. D. „ Oc. R.	12 53 58 15 25	8 10·9
Sat	3			1st Sh. I. „ Tr. I. „ Sh. E. „ Tr. E.	10 14 10 30 12 29 12 44	8 52·1
Sun	4	13 51 14 48 15 30	Conjunction of Mercury and θ Ophiuchi 0° 9′ S. Occultation of B.A.C. 830 (6) Reappearance of ditto	1st Ec. D. „ Oc. R. 2nd Ec. D.	7 29 35 9 51 15 26 56	9 33·6
Mon	5			1st Sh. I. „ Tr. I. „ Sh. E. „ Tr. E.	4 43 4 56 6 58 7 10	10 16·3
Tues	6	9 40	Near approach of B.A.C. 1272 (6)	1st Oc. R. 2nd Sh. I. „ Tr. I. „ Sh. E. „ Tr. E.	4 17 12 34 12 53 15 12 15 32	11 0·8
Wed	7	14 39 19 17 15 30 16 30	○ Full Moon Superior Conjunction of Venus and the Sun Occultation of *l* Tauri (5½) Reappearance of ditto	3rd Sh. I. „ Tr. I. „ Sh. E. „ Tr. E.	11 17 11 55 13 52 14 23	11 47·4
Thur	8	2 57 4 27	Conjunction of Moon and Jupiter, 1° 7′ N. Occultation, reappearance of ζ Tauri (3½)	2nd Ec. D. „ Oc. R. 1st Sh. I. „ Tr. I. „ Sh. E.	7 45 10 35 17 40 17 47 19 55	12 36·0
Fri	9			1st Ec. D. „ Oc. R.	14 50 24 17 8	13 26·3
Sat	10	21 41	Conjunction of Moon and Uranus, 0° 56′ S.	2nd Sh. E. „ Tr. E. 1st Sh. I. „ Tr. I. „ Sh. E. „ Tr. E.	41 30 4 38 12 9 12 13 14 24 14 28	Jupiter — 12 6·1
Sun	11	11 4 12 12 15 48 16 43 15 58 16 42	Occultation of η Cancri (6) Reappearance of ditto Occultation of 39 Cancri (6) Reappearance of ditto Occultation of 40 Cancri (6) Reappearance of ditto	1st Ec. D. „ Oc. R.	9 19 3 11 34	12 1·6
Mon	12			1st Sh. I. „ Tr. I. „ Sh. E. „ Tr. E.	6 38 6 39 8 52 8 54	11 57·0
Tues	13	1 0	Opposition of Jupiter and the Sun Saturn's Ring: Major Axis = 34″·0 Minor Axis = 15″·3	1st Oc. R. 2nd Tr. I. „ Sh. I. „ Tr. E. „ Sh. E.	6 0 15 9 15 10 17 46 17 48	11 52·5
Wed	14			3rd Tr. I. „ Sh. I. „ Tr. E. „ Sh. E.	15 9 15 16 17 39 17 52	11 48·0
Thur	15	9 10 7 40	☾ Moon's Last Quarter Conjunction of Moon and Mars, 3° 0′ S. Illuminated portion of disk of Venus = 1·000 of Mars = 0·002	2nd Oc. D. „ Ec. R. 1st Tr. I. „ Sh. I.	10 12 12 54 19 31 19 35	11 43·5

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DATE		Principal Occurrences		Jupiter's Satellites		Meridian Passage
		h. m.			h. m. s.	h. m.
Fri	16		Sidereal Time at Mean Noon, 17 39 42·1	1st Oc. D.	16 37	Jupiter
				„ Ec. R.	18 55 28	11 39·0
Sat	17			2nd Tr. I.	4 16	
				„ Sh. I.	4 28	
				„ Tr. E.	6 52	
				„ Sh. E.	7 6	
				1st Tr. I.	13 56	11 34·5
				„ Sh. I.	14 3	
				„ Tr. E.	16 11	
				„ Sh. E.	16 18	
Sun	18		Meridian passage of the Sun, 3m. 10s. before Mean Noon	3rd Oc. D.	4 41	
				„ Ec. R.	7 41 36	11 30·0
				1st Oc. D.	11 3	
				„ Ec. R.	13 24 12	
Mon	19	8 4	Conjunction of Saturn and Mars 1° 18″ S.	1st Tr. I.	8 22	
				„ Sh. I.	8 32	11 25·5
				„ Tr. E.	10 37	
				„ Sh. E.	10 47	
Tues	20			1st Oc. D.	5 29	
				„ Ec. R.	7 52 52	11 21·0
				2nd Tr. I.	17 23	
				„ Sh. I.	17 47	
Wed	21			1st Tr. E.	5 3	
				„ Sh. E.	5 16	11 16·5
				3rd Tr. I.	18 24	
				„ Sh. I.	19 17	
Thur	22	0 18	● New Moon			
			Eclipse of the Sun; visible at Greenwich			
		0 54	Conjunction of Moon and Saturn, 0° 0′	2nd Oc. D.	12 25	
		6 24	Conjunction of Moon and Mars, 1° 6′ S.	„ Ec. R.	15 30	11 12·0
		10 4	Conjunction of Saturn and the Sun			
Fri	23	5 56	Conjunction of Moon and Mercury, 1° 19′ S.	1st Oc. D.	18 21	11 7·5
Sat	24			2nd Tr. I.	6 30	
				„ Sh. I.	7 5	
				„ Tr. E.	9 7	
				„ Sh. E.	9 43	
				1st Tr. I.	15 40	11 3·0
				„ Sh. I.	15 58	
				„ Tr. E.	17 55	
				„ Sh. E.	18 13	
Sun	25			3rd Oc. D.	7 56	
				„ Ec. R.	11 42 27	10 58·5
				1st Oc. D.	12 47	
				„ Ec. R.	15 19	
Mon	26			2nd Ec. R.	4 48	
				1st Tr. I.	10 6	
				„ Sh. I.	10 27	10 54·0
				„ Tr. E.	12 21	
				„ Sh. E.	12 42	
Tues	27			1st Oc. D.	7 13	Moon
				„ Ec. R.	9 47 49	4 40·0
Wed	28	6 35	Occultation of 30 Piscium (5)	1st Tr. I.	4 32	
		7 49	Reappearance of ditto	„ Sh. I.	4 55	5 25·1
		8 46	Occultation of 33 Piscium (5)	„ Tr. E.	6 47	
		9 48	Reappearance of ditto	„ Sh. E.	7 10	
Thur	29	4 38	☽ Moon's First Quarter	1st Ec. R.	4 16 39	
				2nd Oc. D.	14 40	6 8·0
				„ Ec. R.	18 6	
Fri	30					6 49·6
Sat	31			2nd Tr. I.	8 46	
				„ Sh. I.	9 41	
				„ Tr. E.	11 23	7 31·0
				„ Sh. E.	12 20	
				1st Tr. I.	17 24	
				„ Sh. I.	17 53	

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THE PLANETS FOR DECEMBER.

At Transit over the Meridian of Greenwich.

Planets	Date	Right Ascension	Declination	Diameter	Meridian Passage
		h. m. s.	° ′		h. m.
Mercury	1st	16 49 50	−23 52	4″·6	0 9·3
	15th	18 26 11	25 31½	5″·0	0 50·3
Venus	1st	16 28 10	−21 33½	9″·8	23 43·7
	15th	17 38 36	23 40	9″·8	0 2·8
Mars	1st	11 18 49	+6 40½	7″·5	18 35·2
	15th	11 42 40	4 22½	8″·3	18 3·9
Jupiter	1st	5 29 19	+22 45	44″·6	12 46·7
	15th	5 21 12	22 40	44″·8	11 43·5
Uranus	15th	7 51 40	+21 31	4″·2	14 13·6
Neptune	3rd	1 13 36	+5 57	—	8 23·8
	19th	1 12 58	5 53½	—	7 20·2

Mercury may be observed at the end of the month; it passes the meridian on the 31st about an hour and a half after noon, and may then be seen in the evenings, setting after the Sun.

Venus arrives at superior conjunction on the 7th of this month, passing behind the Sun, and consequently is very unfavourably situated for observation during December. The planet is in conjunction with Saturn on the 19th.

Mars may be seen in the morning up to daybreak, passing the meridian about half-past six A.M. at the beginning of the month, and about half-past seven at the end of the year, at which time the planet is about 2° above the equator, but still too small to be observed with advantage.

Jupiter arrives at opposition on the 13th of the month, and is then at its greatest magnificence. The situation of this planet is the best that could be for observation, as regards definition, its great altitude rising above the general causes of atmospheric disturbance. At the end of the year it passes the meridian about half-past 10 o'clock.

Uranus may now be observed during the latter part of the night in the north-east. The planet passes the meridian about three o'clock in the morning at the beginning of the month.

Neptune continues to be well situated for observation during December, passing the meridian about half-past 6 in the evening on the last day.

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The minor planet **Astræa** arrives at opposition on the 28th of December. The following are the positions at transit:—

	Right Ascension.				Declination North.	
	h.	m.	s.		°	′
December 20 ...	6	34	50	...	17	7½
22 ...	6	32	57	...	16	12½
24 ...	6	31	1	...	16	17
26 ...	6	29	3	...	16	22½
28 ...	6	27	3	...	16	28
30 ...	6	25	4	...	16	34
31 ...	6	24	4	...	16	37

Meridian passage:—Dec. 7th, 13 38·9; 17th, 12 51·8; 27th, 12 3·0.

D'ARREST'S COMET.

Communicated by G. F. Chambers, Esq.

Ephemeris for December.
Berlin Mean Moon.

	R.A.				N.P.D.	
1870.	h.	m.	s.		°	′
Dec. 1 ...	22	29	35	...	113	24
3 ...	22	36	16	...	112	56
5 ...	22	42	51	...	112	27
7 ...	22	49	17	...	111	57
9 ...	22	55	37	...	111	26
11 ...	23	1	50	...	110	55
13 ...	23	7	55	...	110	23
15 ...	23	13	54	...	109	51
17 ...	23	19	47	...	109	18
19 ...	23	25	34	...	108	45
21 ...	23	31	15	...	108	12
23 ...	23	36	50	...	107	39
25 ...	23	42	19	...	107	5
27 ...	23	47	43	...	106	32
29 ...	23	53	2	...	105	58
31 ...	23	58	17	...	105	25

Windyhills Observatory, Bickley:
November 2, 1870.

NEW WORKS.

The Forces of the Universe. By George Berwick, M.D. Longmans, Green, & Co.

Magnetic Survey of the Colony of Victoria. By G. Neumayer, Ph. D. Mannheim, J. Schneider, 1869.

At this time, when we have visibly seen so vividly some of the influence of electricity upon our planet, we welcome the important additions to scientific literature of the two books above mentioned. Without following Dr. Berwick to all his conclusions, we recommend the study of his small and readable volume to those who are turning their attention to the powerful-all-powerful, as the writer of the "Forces of the Universe" would seem to affirm—agency of electricity, and through it of magnetism.

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Starting from the well-known laws of this all-pervading power, he shows the enormous influence which must necessarily follow, if not to the extent which he thinks. "We must," says he, "look upon the earth as a vast magnet, but nevertheless similar in every respect, so far as magnetism is concerned, to the tiniest little magnetised needle which vibrates in our hands. There is a north magnetic pole near the north axial pole of the earth, towards which the south poles of all magnets are attracted; there is a space of equal attraction existing in equatorial regions similar to the mid-space of a bar magnet, and there is a south pole in the southern regions of our world towards which the north poles of all magnets are attracted." This great magnet is isolated by an envelope of atmosphere, and, on a gigantic scale, must act in a similar way to any magnet similarly placed. Starting from these premises, the writer alleges that most, if not all of the phenomena of nature can be explained. The photosphere of the sun and its corona; some of the great puzzles connected with the tides, the motion of planets and comets. Heat, light, and electricity, and magnetism are identical. *The rotation of the earth is caused by polar and equatorial currents!* and one great electric discharge may be the end of our orb, reducing it to the barren, soundless, desert-like appearance of the moon.

Dr. G. Neumayer's comprehensive accounts of his magnetic survey of the Colony of Victoria, which has been delayed for want of funds, has at last appeared. It is not only very full of useful information upon the subject of which it specially treats, but contains an interesting description of the various trips he took, of the pleasures, troubles, and hardships of his journeyings. Finding that stopping at inns and friends' houses interfered with his labours, he took with him all materials and implements necessary for camping. In the eastern parts he was obliged to travel without any conveyance, his implements and instruments having to be carried by horses. He says that he performed the distance of 12,000 miles, using only five horses in all. He gives us information of the customs, fauna, flora, and language of the various parts. At one time the oil of his cart-wheels caught fire, he is half-killed with mosquitoes and flies; but the worst trouble seems to have been want of water, being at one time fortunate in having a little rain-water left in a cask, at another when having bored between 20 to 30 feet for it, they found it too brackish to drink. His notices of the Burke expedition are not without interest. The reader should notice the descriptions of the great meteorites. The book is illustrated by plain and elaborate maps.

STAR CATALOGUE.—What is the best star catalogue or atlas of small stars below the sixth magnitude? I have the B. A. C., but it only goes to the seventh magnitude. I think the information would be useful to others as well as myself.—R. C. J.

NOTICES TO CORRESPONDENTS.

We are obliged to postpone several valuable communications, from want of space.

The paper on the Astral Hebrew alphabet is presented to the subscribers of the Register, by the Rev. J. H. Broome.

The Astronomical Register is intended to appear at the commencement of each month; the Subscription (including Postage) is fixed at **Three Shillings** per Quarter, *payable in advance*, by postage stamps or otherwise.

The pages of the *Astronomical Register* are open to all suitable communications. Letters, Articles for insertion, &c., must be sent to the Editor, Mr. S. GORTON, *Parnham House, Pembury Road, Clapton, N.E.*, **not later than the 15th of the month.**

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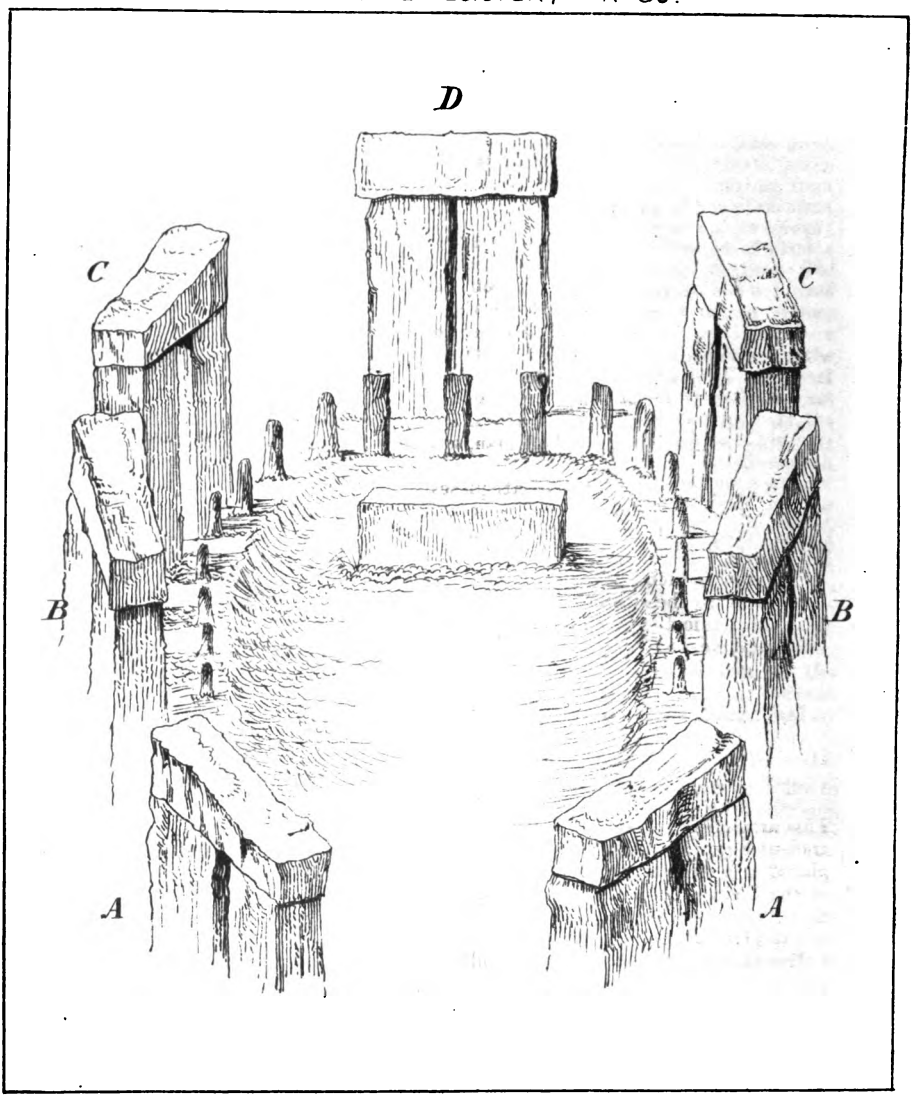

ORIGINAL PLAN
Of the Seven Trilithons and Altar,
at Stonehenge.

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THE ASTRONOMY OF, AND DRUIDICAL WORSHIP AT STONEHENGE.

BY THE REV. JOHN H. BROOME,

VICAR OF HOUGHTON.

In the September No. of the ASTRONOMICAL REGISTER, the writer has shown the astronomical knowledge exhibited by the Druids in their temple at Stonehenge, whereby they affixed both the season, and year date of its erection, to be verified by posterity. From two visits made to Stonehenge in October 1868, with a view to discover what relation its temple bore to astronomy, he became aware, that Druidical Astronomy was not limited to the season and year date of its erection, but that they had actually constructed their grand trench, and two outer circles as far as the Trilithons surrounding the altar, marked D in the first plan, to represent the whole compass of the heavens.

Within the trench on the frontispiece of the plan in the September No., to which at present we refer, were originally five stones, standing at unequal distances, two of which only are now remaining, though the foundations of all can be traced.

The stone which is now fallen flat, marked B on the trench, bore no relation to these five stones, being of the same height and size as the astronomical stone marked A.

Should we hazard a conjecture as to the use of this stone, we should say, it might serve to mark the entrance into the grand trench.

This great trench appears to have been designed to represent a circular planisphere, with the five planets* of which the ancients had knowledge, viz. Jupiter, Venus, Mercury, Mars, Saturn, placed at irregular distances. The space within the outer circle marked C, to have been the zodiacal course of the sun through the twelve signs. This arrangement corresponds exactly with that observed in the very ancient Egyptian planisphere of Dendera, the five planets there being placed in a circular position, at irregular distances, the twelve signs of the Zodiac succeeding, also circular. Next we see the constellations, and these also appear circling round the heavens. Thus it is, in the plan or planisphere of the September No.

The thirty-six stones of the second circle of the planisphere, wholly unhewn, and very irregular in their forms, varying in height above the ground, from 5 to 6 feet, in breadth, from 1½ to 4½—(by which we may judge of the whole as they originally stood,) represent the

* In the 1st article, 2 of these stones have been named as marking the summer and winter solstices. The ancient astronomers made use of what these stones represent, as in fact they did of stars themselves, as guides or pointers.

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varying sizes of the thirty-six constellations, not including those of the twelve signs of the Zodiac. The relative size of each constellation is attended to in the Dendera planisphere, by the varying sizes of living creatures of creation.

Forming the third circle in the original plan in the September No., is another and very peculiar circle, being in fact an ellipse of what is called the 7 Trilithons, i.e., three stones, two upright ones, and one placed on the top of each, given more fully in the present illustration. The uprights of the first pair marked A, were probably about 8 feet above the surface of the ground. Those of the second pairs, marked B, sixteen feet. Those of the third, marked C, 17, and those of the central ones, marked D, 22.

There appears to have existed among all nations a tradition of six days of creation, the seventh being the day of cessation or rest. Porphery states that the Phœnicians consecrated the seventh day as holy. That the Druids, deriving from the Phœnicians, and through them from the ancient Egyptians, whose founder was Mizraim, grand-son of Noah, should have known this is nothing extraordinary, nor their wish to perpetuate such a memorial by their erection of these 7 Trilithons, marking the six days of progressive creation, the seventh, the highest, the day of rest. With this view it seems reasonable that the highest Trilithon, now called the altar Trilithon, should be placed where it is, the altar being the exact breadth of this highest Trilithon. The space between the altar and this Trilithon is called even now "the priest's standing place."

We now return to the elliptical form in which the 7 Trilithons are placed, as illustrated in the present diagram, this part of the interior of the temple being, in the present illustration, fully given.

It is a discovery as we think, of modern science, that the shape of the earth is an imperfect ellipse, but the fact seems to have been noticed by the ancient Druids in the construction of their temple, combining at once a system of astronomy and religious worship.

That the ancient astronomers knew more than we now give them credit for, appears from the fact that the Arabic name "Wasat," which means the centre or foundation, as of the Pleiades, was given in the Arabic catalogue of stars, drawn up by Ulugh Beigh, a Tartar prince and astronomer, who flourished about the middle of the 15th century.

Al-Cyone is the chief star of the Pleiades. Al was the ancient Hebrew, and is now the Arabic article applied to its name. כון "Kyon," is the Hebrew root for centre or foundation. The meaning of this name Kyon, centre, or foundation, anticipates one of the greatest achievements of modern astronomy, that to this centre gravitates the whole magnificent arrangement of stars, called the Galaxy, to which our sun belongs.*

The name Taygeta, another of the stars of the Pleiades, means in its Hebrew root "bound together as a bunch." There may be some connection between the Grecian fable of Atlas supporting the heavens, and the constellation of the Pleiades,† from this discovery that in this group is the centre of gravitation, or mutual attraction,

* Mazzaroth, p. 28.

† By the telescope, as its powers are increased, still more and more stars are discernible in this group; two of their names, "Maia," and "Electra," in their Hebrew roots, signify abundance. Those who gave them *saw* them to be a *multitude*.—Mazzaroth, p. 28.

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by which all the heavenly bodies are kept together and supported from falling.

This connection seems clearer, when we remember, that the names of the 7 stars of the Pleiades, Maia, Electra, Taygeta, Celene, Merope, Asterope, Al Cyone, were said to be the names of the daughters of Atlas the supporter of the heavens, who, after their death, were placed to form this constellation.

That the ancients knew so much of astronomy need not seem so very surprising if we are to credit Josephus, when he says "The family of Seth the son of Adam invented the science of the celestial bodies." He refers for this to ancient authorities B i, C iii and iv. In the notes to Gill's Commentary on Genesis are the names of ancient writers, Jewish, Persian, and Arabian, by whom these traditions have been transmitted. The extreme term of life of the early patriarchs enabled them to ascertain the return of the heavenly bodies to the same positions in cycles and periods, which in after ages it has required the labour of successive generations to verify.

We now refer to the Druidical worship at Stonehenge. It was within the 19 stones placed around the 7 Trilithons in the shape of an ellipse, that their worship was conducted in front of the altar, its length, the breadth of the highest Trilithon; the Druidical high priest, facing the east, offered up his sacrifice on the altar. But his worship was a perverted one, (retaining some knowledge of truth) of the sun, moon, and planets, connecting them with the Phœnician idolatry of Baal, which King Josiah at his reformation put down:—"And he put down the idolatrous priests whom the kings of Judah had ordained to burn incense in the high places in the cities of Judah and in the places round about Jerusalem; them also that burned incense unto Baal, to the sun, and to the moon, and unto the planets and to all the host of heaven."—II Kings, xxiii, 5. Probably the earliest worship on record in this country, was imported by the Phœnicians. It was in 910 B.C., under king Ahab, that Baal-worship was in its most flourishing state, 67 years later than the date assigned in the previous article to the erection of Stonehenge. In that article we have attempted to show the cause of our chancels being placed to the east, a custom we most probably derived from our ancient Druidical teachers. They placed the grand entrance of their temples to the east, their altar to the west, as it was in the temple at Jerusalem. Both Roman-Catholics and Protestants appear to have derived the custom of placing their altars and sacramental tables east and west, also the nave of their churches, from the aditum of Stonehenge, that space between the entrance of the temple at Stonehenge, as in the first plan, and the sacred precincts plainly illustrated by the 19 circular stones of the second plan.

It will make Stonehenge of greater interest to us, if we can trace both the science of astronomy in some of its bearings, and even the constructive origin of our ecclesiastical buildings, to this ancient temple, connecting us as it does with a nation so highly cultivated in the arts and sciences as the Phœnicians; with whom even King David thought it not beneath him to form an alliance, and Solomon his son found in Hiram ("always a lover of David") a ready helper in the building of his temple. Should there be doubt on the mind of any of the Phœnician character of the temple at Stonehenge, we

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would state the opinion of Samnes in his "Britannia Antiqua Illustra," 1676, p. 395, which gives a Phœnician origin to Stonehenge. He is of opinion that this pile was dedicated to Hercules, to whom the Phœnicians built altars and erected temples, he being their tutelar deity, whom they adorded as the sun*. The learned Bryant apprehends that there is hardly a temple in the world prior to Stonehenge, Vol. II., p. 533.

It was considered by some as a proof of the Phœnician origin of the temple, when, in the reign of Henry VIII., a table composed of tin and lead was dug up at Stonehenge, with unknown characters, which some learned men of the time supposed to be Phœnician. The name of *Druid* may also be derived from the Hebrew "Druss," translated 'contemplator,' or seer. To the myseltoe used in their worship Virgil, in the Sixth Æneid, alludes; the self-springing plant, held in veneration by the northern nations, sought out and cut off with mystic ceremonies. This custom evidently owes its origin to the universal tradition that the "Seed," Genesis iii. 15, "the Branch," "the Plant of renown," the Desire of all nations," was to be cut off, "but not for Himself," and should be born out of the common course of nature, as the myseltoe was supposed to be produced.

But the Druids knew nothing of this, or that by human sacrifices they prefigured the One great atoning Sacrifice for sin.

The religion they taught, though corrupted truth, was, perhaps, better than a blind and ignorant worship of stocks and stones. It may be interesting to some to observe how astronomy, connected with the temple at Stonehenge, links together the ecclesiastical architecture and religious worship of the most distant ages and countries.

* The author of the hymns of "Orpheus," seems to identify Hercules with the sun. Porphery, who was born in Phœnicia, assures us, that the name of Hercules was given to the sun, and that the fable of the 12 labours expresses the progress of the sun through the 12 signs of the Zodiac. The Scholiast of Hesiod says, "The Zodiac, in which the Sun performs his annual course, is the career of Hercules in the fable of the 12 labours.—(*Dupuis, Origine des Cultes. p.* 108.)

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THE ASTRONOMICAL REGISTER.

APPENDIX TO No. 93.

ON THE PRIMEVAL SYMBOLISM OF THE GREAT BEAR AND ORION.

—— Probabilia conjecturâ sequens.
CICERO, *Tusc.* i. 9.

I PROPOSE to apply the general principle of "Mazzaroth," as indicated in the "Origin of the Signs of the Zodiac" (*Astron. Register*, 1867, Appendix) to some other constellations.

To render the explanation of a constellation symbol probable, the following requirements should be satisfied:—1. The person or thing signified must be of great, if not primary, importance. 2. The name should be easily suggestive of such person or thing. In the next place, there will be a considerable increase of probability that the right interpretation is obtained, if the emblem appears to be appropriately associated or grouped with others also answering to the above conditions; and this probability will further be increased if its ancient mythology seems to embody some features or fragments of inspired tradition, and if a reliable derivation of names points in the same direction.

We have four ancient names of the Great Bear. 1. *Arktos*, She-bear; 2. *Hamaxa*, Waggon (both in Homer). 3. *Ayish* (Job). 4. *Banát n'ash*, Daughters of the bier (Arabian). In deciding upon the most ancient of these (and probably the primitive one), we may at once reject the second, as well on account of the name itself, as the way in which it is mentioned: "The She-bear, which they call also the Wain." Assuming Job to have lived 700 years, more or less, before Homer, there will be some ground for expecting a similarity between Arktos and Ayish. Now *Ayish*, or *Ash*, is considered by Schultens to be the same as the Arabic *ăs*, nightly watcher, from the root *ăsa*, and *ăssa*, to go about by night. Ayish may mean, then, the bear prowling at night, and may have become virtually a proper name. As pointing to the antiquity of "the Bear," it is curious that the Iroquois

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Indians were found to call the constellation by this same name, though its stars have no resemblance to the animal.

If we take the Bear then as the original name, of what is it likely to have been the symbol? Looking to Scripture, we find the ferocity and voraciousness of the bear frequently alluded to; and the variety of the Asiatic bear which inhabits the Himalayas is especially ferocious, and it is probable that the same species among the mountains of Armenia is the animal of Scripture.* It would, therefore, be a very suitable emblem of *Death*; and it is also highly probable that the primitive sphere would not be without an emblem of this kind. The fourth name, *Banát n'ash*, would indeed be a direct memorial of death—a funeral procession pursuing its slow but ceaseless circling round the pole (κ Draconis at the time of Job, and α Draconis at a still earlier period); and *Ayish* is derived by some from the Arabic *n'ash*; but there is some awkwardness in this derivation, for "Ayish and her sons" (Job xxxviii. 32) would thus mean "the bier and her sons," whereas "the prowling one and her sons" is natural. Moreover, *Banát n'ash* is perhaps too artificial to be of the very highest antiquity; and the Arabian emblem cannot, as will be seen presently, be so well grouped with others. Still, it may be a variation of the original at a remote period, and perhaps designedly conformed in the main to the intention of the framers of the primitive sphere in regard to this asterism. It stands in singular contrast, both with other names in the constellation relating to antelopes, of undoubtedly Arabian origin, and with those such as *Dúbb*, Bear, which *may* (but this is uncertain) have been introduced from Ptolemy.

The above explanation of the symbol of the "Bear" is supported by its proximity to Draco, representing the Serpent, who suggested the sin of which death was the consequence and penalty. It is further corroborated by another neighbouring figure, which is known, as it was by Homer, as Boötes, the ploughman or waggoner; but this evidently relates to the *hamaxa*, or waggon he was supposed to drive, and must therefore be rejected, with it, in favour of Arktophulax, the Bear-keeper, as it is called by Aratus, a man supposed to be watching the bear. Arcturus, the principal star, also means Bear-watcher, or Bear-warden, and is twice mentioned by Hesiod. There can be little question but that we have here an emblem—one of the many that shine in the heavens—of Him who from the beginning has exercised a control over the ravages and reign of Death, and kept within prescribed limits both it and the Enemy who has the power of it—(Heb. ii. 14). One of the Arabic names (for there

* Smith's *Dictionary of the Bible.*

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are several) of this constellation is remarkable, *Háris-as-Semá*, Keeper of Heaven. It may be some trace of primitive tradition in relation to the above view.

Turning now to mythology, the common legend about the nymph Kallisto is altogether too trivial to be accepted as the origin of the name of this fine constellation. Of its mythical connection with the goddess *Artemis herself*,* one of whose epithets was *Kalliste*, Müller says: "It is probable (and it is even said to have been sung by Hesiod) that the name of the Bear originated with the Arcadians, to whom the animal was a symbol of their much-honoured goddess Artemis."† But the Arcadians, the most ancient inhabitants of Greece, and of Pelasgian origin, are more likely to have brought both the goddess and her symbol from the East; though the former came to be but a local deity with them, and lost the distinguishing features of the Homeric Artemis, who was a deity of universal worship,‡ and whose great function, shared with Apollo, was that of being the minister of Death.§ Later mythology, which may in some cases have preserved original ideas not to be found in the more ancient, confirms the association already indicated. The maidens who served the Taurian Artemis at Brauron, in Attica, were named *Arktoi*, She-bears; and the goddess herself, in some singular traditions, is represented as a bear calling for human blood.‖ Persephone, the queen of the under-world, was also, in the later mythology, identified with Artemis.

Mr. Gladstone says: "Diana [Artemis] was an earthly, Persephone a subterranean, reflection of Apollo."¶ Sir W. Jones identified the Taurian Diana with Cali, the wife of Siva, in his character of the *Stygian* Jove. "To this black goddess with a collar of golden skulls . . . human sacrifices were anciently offered" ** (as to the Taurian Diana).

The considerations in favour of recognising in the constellation of the Bear the symbol of death may thus be briefly summed up. It is likely that such a symbol would have a place in the primitive sphere, and that the conspicuousness of the asterism would be in keeping with the awful importance of the subject. The bear is, of all animals connected with the area of sacred tradition, the fittest to be an emblem of death (the lion being reserved for another purpose); and we find, in the two most

* Müller, *Dorians*, i. b. 2. 9. Keightley, *Mythology*.
† Müller's *Scientific System of Mythology*, translated by Leitch, p. 133.
‡ Gladstone, *Studies on Homer*, ii. 144.
§ Gladstone, *Juventus Mundi*, p. 306.
‖ Müller, *Dorians*, i. 2. 9.
¶ *Studies on Homer*, ii. 224.
** *Asiatic Researches*, i. 265.

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ancient books we possess, this constellation either called the Bear or by a name that admits of being naturally referred to it. The close neighbourhood of Draco and Arktophulax, emblems readily suggestive of the Serpent and the Seed of the Woman, constitutes with it a group, to which additional impressiveness is given by the constant visibility of Draco and the Bear: one a remembrancer of the ever-present Enemy whose wiles brought in the Destroyer, and the other a grand "memento mori" emblazoned in the sky. And as the Serpent or Dragon was henceforth to be a central power, as it were a pivot round which so much in the mournful destinies of the human race would turn, it is not without significance that his symbolic constellation furnished the polar stars for so many primitive ages. But the saddening thoughts associated with Draco and the Bear were tempered, as above shown, by the hope and confidence inspired by the third emblem in the group. Lastly, without attempting to determine the precise origin of Artemis, we see that there are well marked indications in mythology, both ancient and more recent, that connect the sister of Apollo, the elegant huntress-goddess of Arcadia, the Taurian Artemis, and the terrible Indian Cali, more or less with death, and sometimes with the symbolic bear; and these connections, it is not unreasonable to infer, originated in the idea attached to the constellation in the earliest times of our race.

Admitting the reasonableness and high probability of the principle on which it has been endeavoured to interpret the symbols of the constellations, one can scarcely hesitate about the explanation of Orion. The grandest of all the constellations could surely have been consecrated but to One, and especially to Him as hereafter to be manifested in the blaze of light and glory.* The Hebrew name in Job and other books is *K'sil*, the primary meaning of the root of which is, "to be fat"—whence *K'sálim*, the internal muscles of the loins, "the fat connected with which is a marked type of strength and energy."† *K'sil* here would signify the Strong or Mighty One.‡ The plural, *K'silim* (Isa. xiii.

* See *Mazzaroth or the Constellations*, p. 30.

† *Thoughts on parts of Leviticus*, by B. W. Newton, p. 134.

‡ In numerous passages in the later Hebrew (Psalms, Proverbs, Eccles.) *K'sil* is translated "fool." Mr. Newton (*loc. cit.*) observes: "The energy and strength of the wicked is the energy and strength of folly." Indeed, though the word *K'sel* is used in both a good and bad sense, as "hope," "confidence," "folly," *K'sil* is used in a bad sense everywhere, except it be in the texts where it designates Orion; and Orion may have been called *K'sil* instead of the common word gibbōr (answering to the Arabic *jabbar*), a mighty one, because in Him of whom this constellation was taken as an emblem, alone of all others, strength and energy would be completely

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10), "constellations," is understood to signify the mighty ones, or the "Orions" of the heavens, that is, the brighter constellations. The Arabic name is *Jabbár*, a giant. Orion is mentioned by Homer and Hesiod. It may be rather venturesome to hazard a conjecture about the unknown derivation of this name; but assuming its probable Eastern origin, it may come from the Hebrew *Ōr*, light,* with an ending like the Greek names Kronion, Phokion, &c. A pure Greek equivalent would be Phaëthon, the Shining or Bright One, or Photius. It may be remarked as somewhat singular, that in the name of Hureus, the father of Orion, according to one account, the first part is essentially the same as *ōr*, and that the names of Orion's brothers, Lukos and Nukteus, embody the roots whence came the words *lux* and *nox*, light and night. It is even possible that something like "Orion" may be of the highest antiquity. If we suppose that the full original name was a compound, either *Ōr-K'sil*, the Light of the Mighty One, or *K'sil-or*, the Mighty One of Light, one part or the other of the name used for the whole might be current at different places and periods, and in process of time the other might fall into oblivion. An illustration is offered in Phœbus Apollo, the Bright Averter (of evil), in whom Mr. Gladstone recognises "the darkened shadow of the Saviour,"† for which sometimes "Phœbus," and sometimes "Apollo," alone is used, and (rarely) "Apollo-Phœbus." The expression in Homer, *sthenos Oriōnos*, the strength of Orion, by periphrasis for Orion himself, would, in fact, well represent the second of the above conjectural compounds; but it would not be safe to press it as expressing more than the characteristic quality of Orion, in which respect, apart from the derivation of the name, we find an agreement between the Hebrew, the Arabic, and the Greek. And whether or not embodied in the primitive name, the idea of light and brilliancy could hardly fail to be mentally associated either with *K'sil* or Orion.

The Bear, watched by Arktophulax, is itself represented in Homer as watching Orion, the mighty hunter, whilst turning in her circuit in the sky; so that, as Müller remarks, "we can immediately find, from the position of the Bear's head, the situation of Orion, even though the latter constellation is beneath the horizon."‡ The words are identical, both in Iliad xviii.

consecrated to God. In this solitary instance (as far as we know) with *K'sil* was associated the idea of inward perfectness as well as strength, an idea strongly developed subsequently in the sacrificial institutions, where the fat upon the *K'sālim* and other inward parts was burned on the altar as a sweet savour.—*Levit.* iii. 3-5.

* So the author of *Mazzaroth*.

† *Studies on Homer*, ii. 134.

‡ *Mythology*, p. 334.

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488, and Od. v. 274, as if a traditional and stereotyped phrase, derived possibly from the original arrangement, by which the antagonism of death and darkness with life and light, and the final triumph of the latter, was set forth by these two constellations.

Orion was also called by the Arabians *Jauza*, or the Central One, because the equator passes through the middle of the constellation, which is thus midway between the poles of the heavens. When Orion is on the meridian, the richest portion of the heavens is in view, over which this glorious constellation seems to preside. It may be noticed, too, that Arktophulax (Boötes) and Orion, one or both, are always in view with the Bear. As one is sinking below the horizon, the other rises, and *vice versâ*, so that the memorial of death was always presented to the eye in connection either with the actual control exercised over it by the Great Deliverer, or its final destruction by Him.

Looking to the strange mythology which is connected with Orion, and which assuredly could never have been the origin of the constellation; according to some he was son of Poseidon and Eurualé, both names suggestive of an ocean-born son; he received from his father the power of wading through the depths of the sea; he was of extreme beauty, and a mighty hunter and destroyer of wild beasts; he was violently deprived of his sight, which was restored by the beams of the sun, after he had waded through the ocean towards the East. According to Homer, he was slain by Artemis with her arrows. Another account says that Artemis caused a scorpion to issue from the earth, by which Orion was stung in the ankle and killed. So much, perhaps, of primitive tradition may be supposed to underlie these legends as transmitted the prophecy of the Sacred Conqueror, subjected to suffering and death, but in virtue of his divinity and resurrection finally triumphant over both. According to Müller, Orion is an ancient god of war and of the chase, worshipped by the early inhabitants of Hyria (Uria) in Bœotia. "The Bœotians of that neighbourhood were somehow reminded of him by the brilliant constellation which has ever since been called Orion."* He ingeniously interprets the myths referring to Orion by a comparison of the appearances of the constellation in the Grecian sky. About this he is clear, that the figure of Orion was in the heavens *before* the myths were framed to explain it.

Immediately beneath Orion is Eridanus, "that mythical non-existent (*τὸν μηδαμοῦ γῆς ὄντα*, Strabo) stream which proved a fruitful source of speculation in ancient, as it has done in modern times."† The name Eridanus is nearly, if not quite, the same as

* *Mythology*, p. 133. † Smith's *Dictionary of Geography*.

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Rhodanus, and would be equivalent to the Hebrew *Yardén*, Jordan, so called from descending, flowing down, like Germ. *Rhon*, *Rhein* (Rhone, Rhine), from the verb *rinnen* (Gesenius). Flowing from the foot of Orion (as Geminus wrote, "the river flowing from Orion"), or the stars called by the Arabians "the throne of Jauza" * (Orion)—it is hardly possible not to recognise in it the river of life shadowed forth in the first Paradise, and to be fully realised in the last (Genes. ii. 10; Rev. xxii. 1).

Such are the considerations on which is rested the explanation I have attempted of the meaning of the groups: 1, of the Bear, the Dragon, and the Bear-watcher; and 2, of Orion and Eridanus; and the probability that there was a connection between the two. A further confirmation of this view is found when we notice that these two groups are united, and formed into one grand picture by the intervening zodiacal sign Gemini, suggestive † of that great mystery of united Deity and Humanity to which it was owing that over the Redeemer the temporary triumph of death was possible, and that it was succeeded by His resurrection, and that as regards his people, death, even now stripped of its terrors, and doomed to destruction from the hour and by the very means of its own triumph, shall in the end be swallowed up in victory.

This great stellar picture, extending from the north pole to where the bright star Achernar, ‡ about 30° from the south pole, marks the end of the river, would thus represent a complete cycle of truth. There is the originator (Draco) of sin, which brought in death (the Bear), the latter, nevertheless, always kept within limits by Him (Arktophulax) who was to be the seed of the woman (Gemini) in the fulness of time, and who, finally revealed in glory (Orion), should destroy death, and become, as it were, the source of the river of life (Eridanus), which should carry blessings to the extreme universe.

GEORGE J. WALKER.

* Possibly once including also α, β, γ, and δ in Lepus, called *'Arsh al Jauza*, the throne of Jauza. Other Arabic names also show that he was considered to be a royal personage: γ is called *Nájid*, Subduer, or perhaps originally *Najíd*, a prince, noble; and π^1, π^2, π^3, π^4, π^5, π^6, and three other stars, forming a curve, are *al taj wa al dhawáib*, the Diadem and the Forelocks—'Tabit,' in the maps, being a corruption of the last word, or of *dhuábah* or *dhuábat*, meaning perhaps here the band hanging down from the diadem held in the figure's hand.

† See *Origin of the Signs*, &c.

‡ From *Ákher-nahr*, the latter part of the River.

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THE

ASTRAL HEBREW ALPHABET.

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ASTRAL ORIGIN OF THE

By the Rev.d J. H. Broome.

The Astral Alphabet	The Corresponding Proportionate Constellation	Name of the Constellation	The Hebrew Alphabet
	Aldebaran	Taurus	א
	Castor, Pollux	Gemini	ב
	a	Cancer	ג
		Leo	ד
	Regulus		
	Spica	Virgo	ה
	Zuben el Genubi	Libra	ו
	Antares	Scorpio	ז
	a	Sagittarius	ח
	a	Capricornus	ט
	a	Aquarius	י
	a	Pisces	כ
	Arietis	Aries	ל
	δ	Eridanus	מ
	Fomalhaut	Southern Fish	נ
		Band of Pisces	ס
	Alcyone	Pleiades	ע

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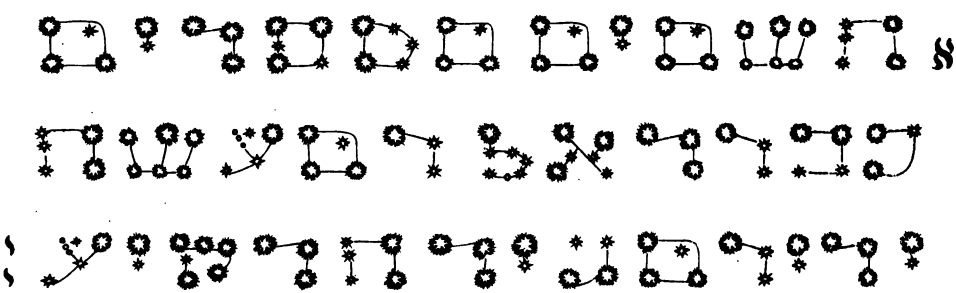
HEBREW ALPHABET.

Vicar of Houghton.

The Astral Alphabet	The Corresponding Proportionate Constellation	Name of the Constellation	The Hebrew Alphabet
	β	β in Taurus	פ
	Betelgeux	Orion	צ
	Rigel	Belt of Orion	ק
	δ	(δ) Canis Major	ר
	Sirius	Canis Major	ש
	a Southern Cross	Southern Cross	ת

ASTRAL HEBREW PSALM. XIX.

יט



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THE ASTRAL HEBREW ALPHABET.

THE Hebrew is the sacred language, the medium of all the earliest knowledge of the human race. That God communicated to Adam a language appears evident, for when He had created every beast of the field, and every fowl of the air, He brought them to Adam to see what he would call them, and whatsoever Adam called them that was the name thereof. (Gen. ii. 19.)

Dr. Johnson observes, that language must have come by inspiration. What, then, became of the first divinely-inspired language? Was it wholly lost at the confusion of tongues and the subsequent dispersion at Babel? Some of the ancient rabbins held that the primitive language is not lost. Faber says: "Some of the ancient rabbinical teachers thought that the present Hebrew character was the original, called *Assurith*, 'blessed,' because God wrote in it the tables of the Law." Max Muller says, in his "Lectures on the Science of Language," "Hebrew was spoken in Palestine from the days of Moses to the times of Nehemiah and the Maccabees, though, of course, with considerable modifications and a strong admixture of Aramean forms, particularly since the Babylonish captivity." How is it then that these "forms," of which Mr. Max Muller speaks as having their origin in Babylon, do not appear in a character which was exclusively used by the Chaldeans, namely, the arrow-headed character? Do we find any trace thereof in the present Hebrew? On the contrary, the Hebrew character preserves its consistency throughout, having all the appearance of being both derived and written at the *same* period by one or more intelligent minds, and afterwards used both in speech and writing.

Some ancient Arabic writers attribute the Hebrew character to Seth, the son of Adam, as well as many of the ancient Jews.* They also affirm, that the science of astronomy commenced in

* Josephus affirms that he had seen inscriptions by Seth, the son of Adam.

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Seth's family. It is remarkable that some of the Jewish rabbins connect the origin of the Hebrew Alphabet with *astronomy*. If such were the case, it would be easy to account how so extremely little should now be known about such an Astral Alphabet. Any certain knowledge of this nature would undoubtedly be lost to the world in the various migrations of the Shemitic tribes, after the confusion of tongues, and consequent dispersion at Babel; and such would be the effect also of the various changes that have taken place since the call of Abraham, the first establishment of the Jewish nation, and the present dispersion of that people.

That astronomy commenced in the family of Seth there is good evidence: Josephus expressly states that "the family of Seth, the son of Adam, invented the science of the heavenly bodies." He refers for this to ancient authorities. Book i., chapters 3 and 4. Many of the names of the stars found in our large celestial globes, though corrupted by Arabian astronomers, have a decided Hebrew origin. It is well known, that the ancient Jews distinguished the twelve signs of the Zodiac by the twelve first letters of their alphabet. They are said to have applied the remaining letters to other constellations. Gaffarelli says: "The constellations were formerly denoted by the Hebrew letters beyond twenty-two to forty-four with two combined, after that, with three; and the letters were instead of animals." Rabbi Kapol, said by Gaffarelli to have been the greatest Jewish astronomer, is mentioned by Southey as having written on the Astral Alphabet. That the primeval language imparted to Adam by his Creator was Hebrew, may be found in the fact, that the names Adam, Eve, Cain, Abel, Seth, are pure Hebrew words, explained as such in the account of their origin. Another strong presumption arises from the fact, that the names of living creatures in Hebrew are remarkably significant of their distinguishing qualities,—indeed, may be said to offer the best definition of them. Again, the names of places given before the confusion of tongues are equally significant,—as Eden, the "happy place;" the land of Nod, of "going forth" or "wandering." It is well known, that the confusion of tongues is, in the original, said to be of the *lip*, or pronunciation, which

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accounts for the existence of Hebrew roots in every language. The Hebrew Scripture is, in fact, the medium of all our earliest knowledge of our own world and the starry heavens. That God should in after ages convey the teaching of His law to man by an alphabet derived in earliest antiquity from the splendours of astronomy, appears reasonable, causing the starry heavens naturally, and by the interpretation of an immutable alphabetical character, to "declare the glory of God." (Ps. xix. 1.)

Impressed with this idea, the writer set himself to ascertain whether there existed a correspondence between the forms of the constellations, and the Hebrew characters of the alphabet.

Virgil, alluding to the very remote period (4000 years B.C.) when the year began in Taurus, says, "The white bull with golden horns opens the year." ("Candidus auratis aperit quum cornibus annum Taurus."—Georg. i. 217.) If, according to most ancient Jewish belief, the twelve signs of the Zodiac were expressed by the first twelve letters of their alphabet, it seemed likely to the author, that a resemblance would be found between the configurations of the *chief* stars in the signs and the twelve first Hebrew letters, beginning in Taurus. See the resemblance in a remarkable degree in the Plate, and not only so, but in their significations also, as given in "Mazzaroth," p. 108, under heading, "Hebrew Alphabet as connected with the Constellations."* It will be seen from the Plate that the remaining ten letters of the Hebrew Alphabet are supplied from the constellations, as tradition reports them to be, and these constellations are Eridanus, the Southern Fish, Band of Pisces, the Pleiades, β in Taurus, Orion, Belt of Orion, δ Canis Major, Canis Major, and the Southern Cross.

In Psalm xix., David says, "The heavens declare the glory of God." The fourth, fifth, and sixth verses seem to set forth the Zodiacal course of the sun through the heavens. "In them hath He set a tabernacle for the sun, Which is as a bridegroom coming out of his chamber, and rejoiceth as a strong man to run a race. His going forth is from the end of the heaven, and his circuit unto the ends of it," &c.

* This work has been distributed to many of the Hebrew faith resident in London, by the late learned author's literary executor.

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As the invention of astronomy is said to be coeval with the invention of the Hebrew Alphabet, at a period when the sun began his annual course in Taurus, time was when the heavens did in a most peculiar degree "declare the glory of God," because the sun, beginning his course in Taurus, would end it in Aries,—the first Hebrew letter of the alphabet for his monthly course corresponding with Alĕph; the twelfth, the last month of his course, corresponding with Lāmĕdh. These two letters, which mark the beginning and the ending of the sun's annual course, when put together, form the Hebrew name for God, אל, "El." Thus it is revealed that the starry heavens show forth the glory of God. Now "El" in Hebrew is of the singular number, one of the persons of the glorious Trinity, and the Hebrews say this one denotes their Messiah.* The Hebrew prophet, still speaking of the stars, says, "Their line is gone out through all the earth;" as if he did say, "The heavens, as a stellar line of great capital Hebrew letters, show unto us God's glory." The sun in his annual circuit, as it were, passes along this stellar line of original alphabet, for of all characters in the world, the square form of the Hebrew letters, when put together, present "a line" which, in a metaphor, may be said to "go out through all the world," and "their words," or divine teaching, "to the end of the world," thus encircling it. It is surely in favour of the extreme antiquity of the Hebrew language, that it preserves the same beautiful square character it always had, notwithstanding the Babylonian captivity, 588 B.C.

That it had a *stellar* origin, the writer has shown from the first verse of Psalm xix., written in the Stellar Alphabet, which he has taken considerable time and pains to trace out from the constellations, not according to fancy, but always from the very constellation, where indications of the appropriate letter would be found, thus narrowing the field of search to that particular and appropriate constellation.

The configurations of some of the Hebrew letters were most difficult at first to draw from what appeared a confused collection

* "All things were made by Him, (the Word,) and without Him was not anything made that was made." (John i. 3.)

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of stars; but gradually the eye accustomed itself to the work, and then it became a real pleasure, bringing its reward when he found the Hebrew letters of the first verse of Psalm xix. were in keeping with the Astral Alphabet he had drawn out. On showing the verse written in stellar character, "The heavens declare the glory of God," &c., &c., to Mr. Deutsch, of the British Museum, himself a Hebrew, that gentleman read off the verse with facility. An attentive observer, on a clear starlight night, even without aid from a glass, will be enabled for the most part to verify the similarity of the starry configurations with the Hebrew letter. Of course, such an one will not look in this our northern hemisphère for stars only to be seen in the southern. But to most eyes, it will require a glass to discover every one of the stars which serve to form the following Hebrew letters:—ב in Gemini, נ in Cancer, ח in Sagittarius, ט in Capricornus, ל in Aries, ע in Pleiades, and פ in Taurus.

In Eastern countries, with a clearer atmosphere than our own, very small stars are plainly seen with the naked eye. By examination from *very correct* celestial globes, each of the twenty-two letters of the Hebrew Alphabet may be traced from the constellations; but the writer is aware if it be the case, that the Hebrew Alphabet is a very close resemblance to the various configurations of the stars, each letter being found only in the particular sign and constellation indicated by the ancient astronomers, the merit of this discovery must rest on a comparison with the stellar system of the heavens, or as it appears, not on any mere planisphere or drawing, but on our best celestial globes. The one he has made use of is Cary's.

The astronomical character of Psalm xix., as setting forth the glory of Christ by the sun in his course, has already been alluded to; but it seems to present itself more forcibly when in the physical sun we see an emblem of Him as "The Sun of Righteousness," and as He shall be called in the latter day by His people Israel, "The Lord our Righteousness."

David, after speaking of the Messiah at the close of Psalm lxxii., adds, "The prayers of David, the son of Jesse, are ended;" thus subscribing his name at the end of these prayers.

As some ancient Arabic writers, and some ancient Jews, attribute the Hebrew character to Seth, the son of Adam, it must

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have been by Divine direction. Now it cannot be a mere coincidence, that the first and second letters of this alphabet when put together spell אב, AB, "father;" and the two last give the name of שת, "Seth;" the two together, אב שת, AB Seth, "Father Seth," he to whom, as we have stated, some ancient Arabic writers attributed the Hebrew character, as well as many of the ancient Jews. Thus the name of the father, after Adam, of all mankind, is incorporated in his own work of an original Astral Alphabet.

There appears to be an undefined apprehension as to the meaning of the Hebrew word אתות, "signs," in Gen. i. 14. In the Hebrew lexicons it is rendered "marks, or signs by which things are distinguished." Astronomical signs in the heavens have been appointed by man from earliest antiquity, marking the monthly and annual Zodiacal course of the sun. But there appears to be a further application of the word אתות, *ōthōth*, "signs," not only as connected with the seasons and nautical observations, but in reference even to a Stellar primeval Alphabet. Now it is worthy of especial notice, that the first and last letters of the Hebrew Alphabet, א and ת, spell this very word את, *ōth*, a "sign" in the singular number, comprehending, as we have shown, (see Plate,) an astronomical formation of the twenty-two letters of the Hebrew Alphabet.

It surely was a further beneficent design of the great Creator, that His stellar "signs" should hereafter be taken for hints—nay, even "heavenly patterns" themselves—for the construction of an Astral Alphabet of the earliest language on record, the Hebrew,* destined to convey to us more fully in Holy Writ the knowledge of His works, commands, and our access to Him through the Son of His love, "the Hope of Israel, the Saviour." (Jer. xiv. 8.) Thus He has spoken to us. First, in astronomy, "A work, glorious, because the shadow of His might." Secondly, by the signs and characters of an immutable Astronomical Alphabet.

* At a meeting of the British Archæological Association at Hereford, Sept. 8, the Rev. Canon Jebb said, "There might be reasons for supposing that Divine Providence first suggested the alphabetical method, and made use of some of those characters which were well known to the Israelites.

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